metal finishing

PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 6 No. 69 (New series) SEPTEMBER, 1960

we gave

156 SQ. FT.

to a customer

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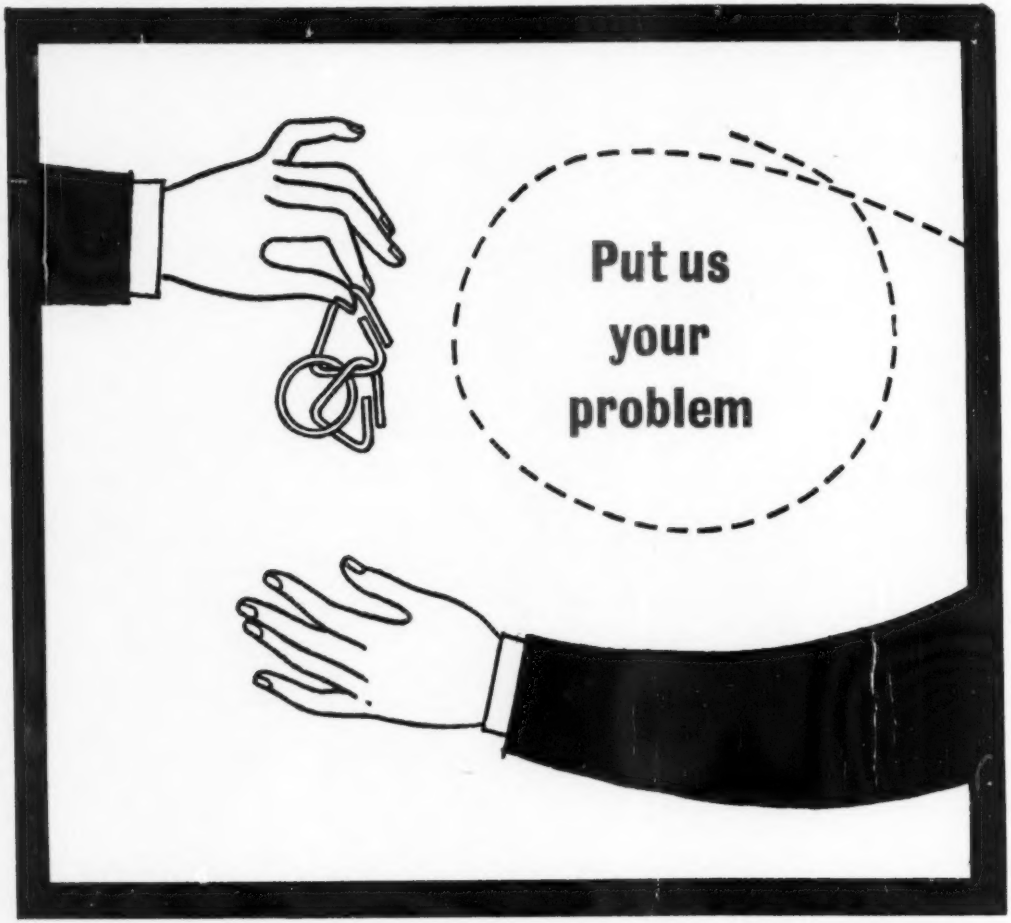

ME6

If it's anything to do with frits, colouring oxides or vitreous enamelling, we can help.

All our frits are shop-tested within our own organisation; all are proved in production and guarantee a fine finish. We are specialists in the production of dry enamels for bath finishes and can offer a fully acid-resisting and alkali-resisting lead-free enamel of exceptionally high workability. These are the sort of problems we have solved—put us on *your* problem. We like problems. Don't hesitate to call us in. MEMCOL is our trade name. Just write:

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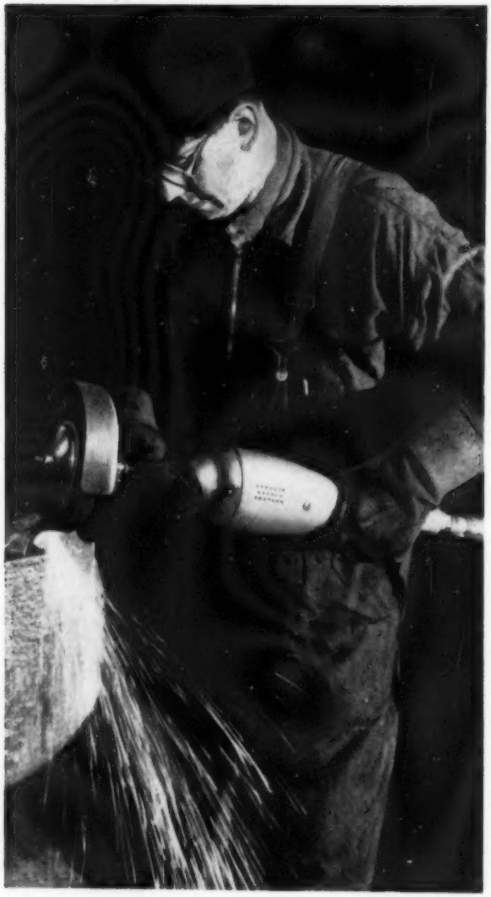


LSR 81

THESE 4 ATLAS COPCO GRINDERS COVER A WIDE FIELD

For sheer capacity in the very heaviest work, can any other portable grinder equal this Atlas Copco LSR81 weighing under 17 lbs.? Recent developments have added no less than 75% to its power output—at the same time features for safer and easier handling have been incorporated. For dressing operations on really heavy castings, this is the grinder. It does the job to perfection—it cuts working time—and it saves money.

Shown also is the Atlas Copco LSR61, a heavy duty grinder with the extremely low weight of 12 lbs. An ideal tool for the whole normal run of jobs—fettling, billet grinding, weld cleaning etc. Output is high—wheel wear and air consumption are low.

Most powerful surface grinder in its class, the Atlas Copco LSS82 shown here is as versatile as it is hard working, and makes the fullest and most profitable use of all the latest developments in re-inforced abrasive discs. Speed 6,000 r.p.m. Weight 11 lbs.

For the small scale precision cutting or grinding job, with mounted grinding wheels and points or with Sandvik Coromant tungsten carbide cutters, today's most highly developed grinder is the Atlas Copco LSF12 shown here. Speed is governed and constant. Accuracy of running extreme. Speed 27,000 r.p.m. Weight 1¼ lbs.

WRITE FOR LITERATURE *Full details about these products are contained in leaflet E811 which will be sent on request.*

Atlas Copco manufactures portable and stationary compressors, rock-drilling equipment, loaders, pneumatic tools and paint-spraying equipment.

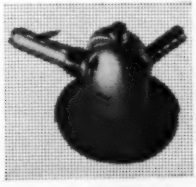
Atlas Copco

puts compressed air to work for the world

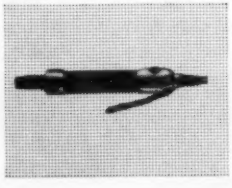
Atlas Copco AB, Stockholm 1, Sweden.

In the U.K.: Atlas Copco (Great Britain) Ltd., Hemel Hempstead, Herts.

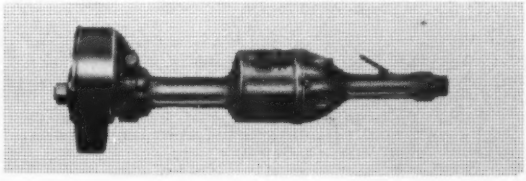
LSS 82



LSF 12



LSR 61



SGB 1

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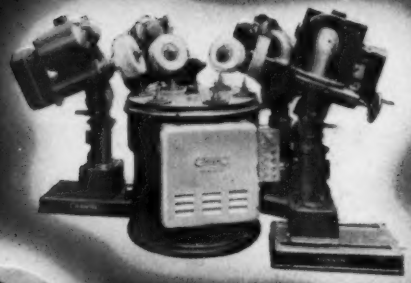
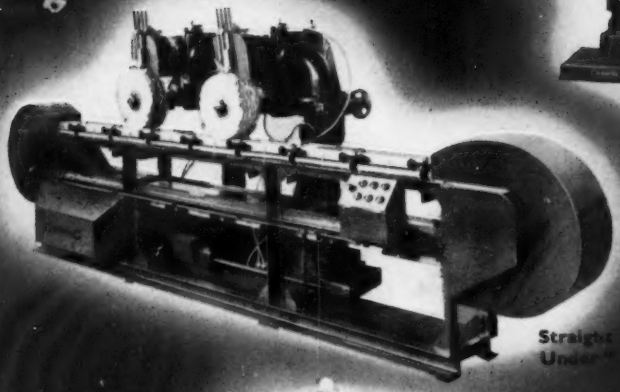
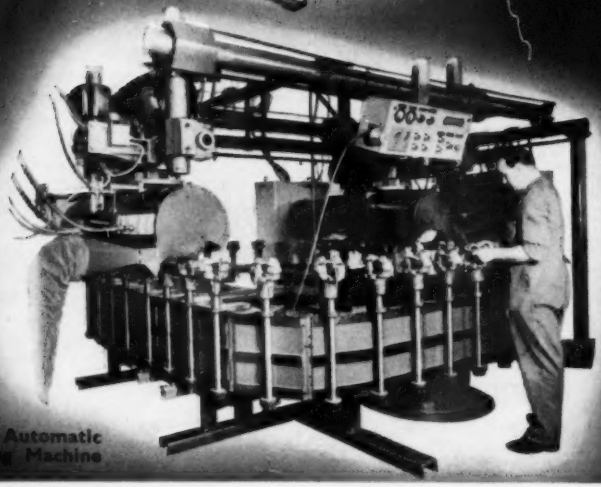
CANNING





Straight Under



Automatic Polishing Machine

AUTOMATIC POLISHING Machines

Automatic Polishing Machines reduce costs and consistently produce a high standard of finish with a high rate of production. In addition to a wide range of indexing and continuous rotary machines, straight line return type conveyor and semi-automatic units are manufactured to meet specific requirements.

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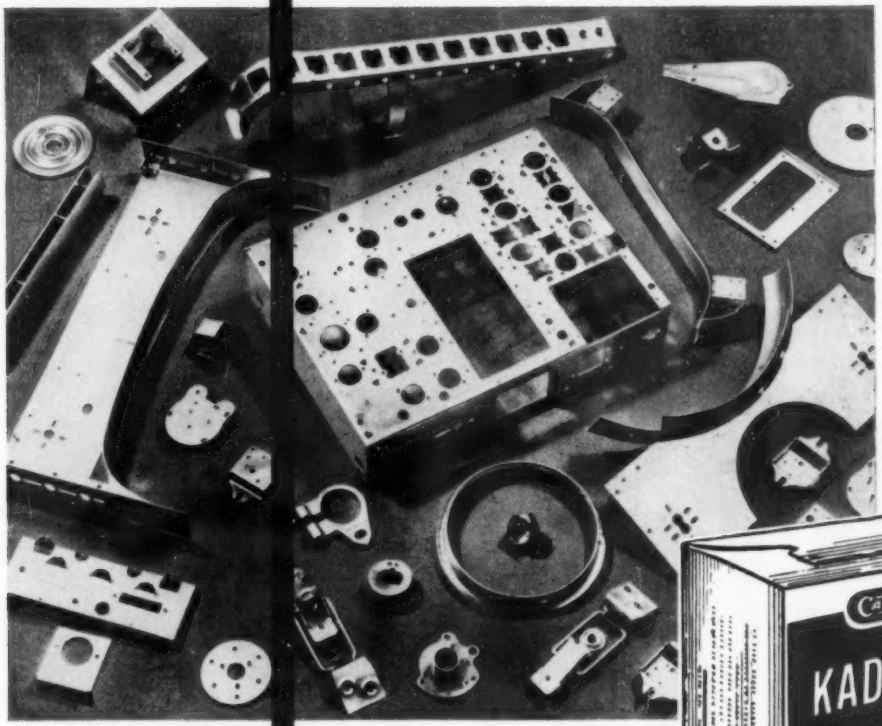

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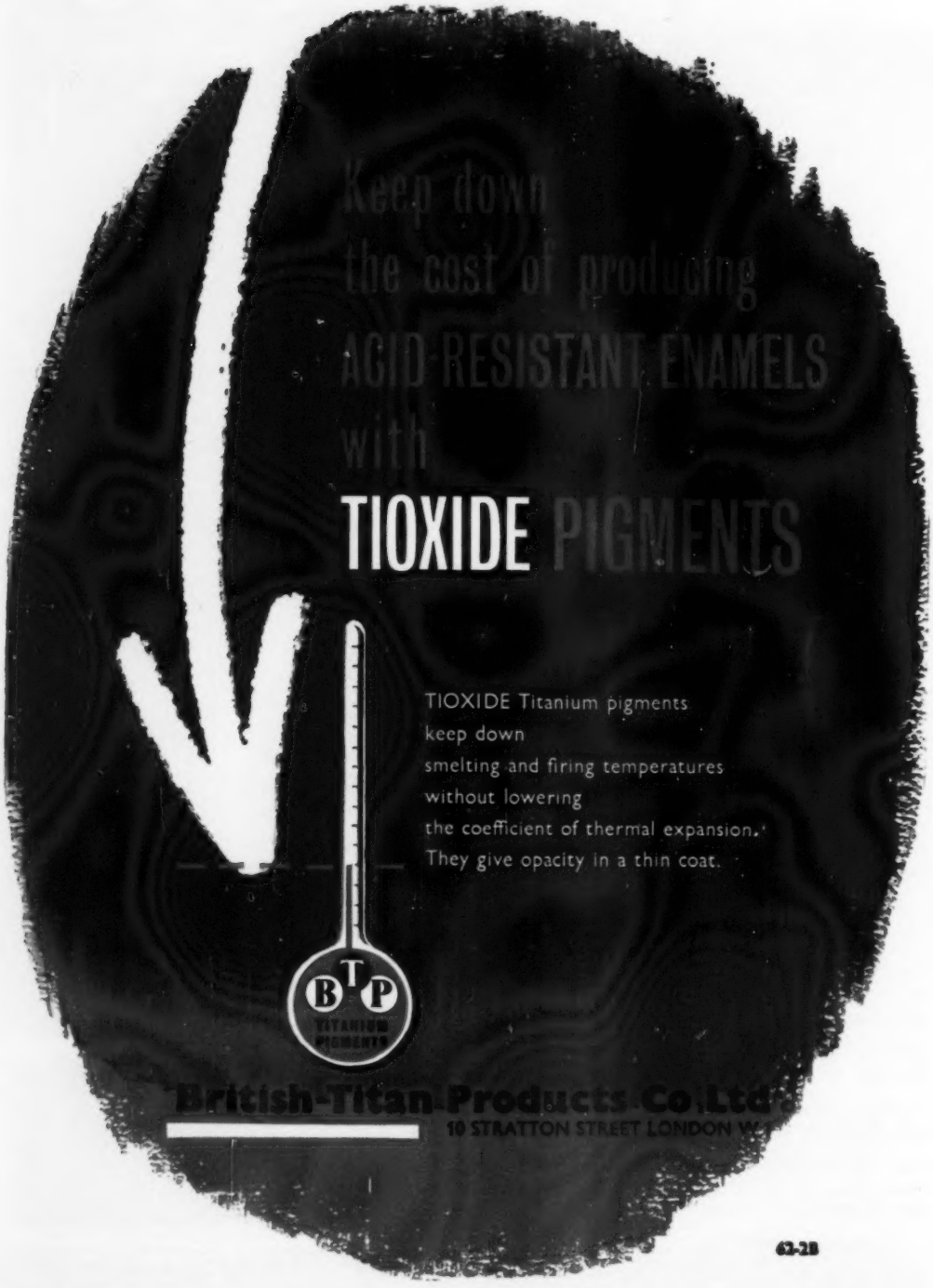
Especially suitable for electrical and electronic apparatus, and for motor and aircraft equipment.

Equally effective for manual, barrel and automatic plating.

Conforms to the requirements of Ministry of Aviation Specification D.T.D. 904.

Ask for Booklet No. 1219 on Canning Cadmium Plating Materials, or for a demonstration of the process at our Technical Centre.

W. CANNING & CO. LTD. **BIRMINGHAM 18 · LONDON · SHEFFIELD & AUSTRALIA**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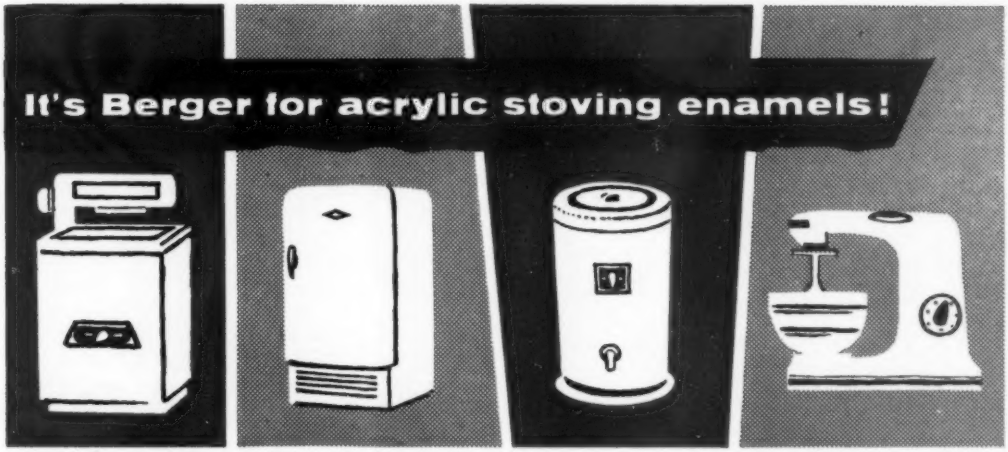


A considerable technological advance now comes to British industry

BERGERCRON
one-coat finish is here!

✳ **PRODUCTION LINE PLUS POINTS**

ONE-COAT BERGERCRON cuts finishing costs and gives a better finish than conventional two-coat systems. It will increase production from existing plant — with fewer rejects because of its exceptional hardness.

✳ **PRODUCT FINISH PLUS POINTS**

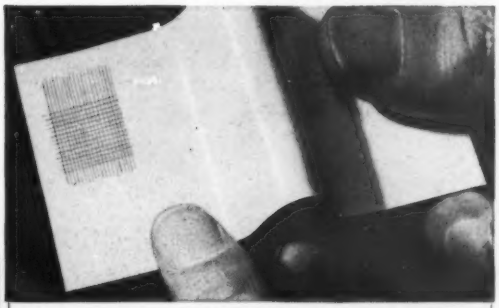
ONE-COAT BERGERCRON has excellent flexibility, gloss and colour retention — white stays white. It is exceptionally resistant to detergents, grease and food staining — superior to all conventional finishes.

NOTE THESE SPECIAL BERGERCRON ADVANTAGES

Detergent resistance — 48 hours in 2½% solution at 160°F.	Outstanding
Humidity — 1000 hours at 100°F and 95% R.H.	No effect
Hot fat resistance — total immersion for 16 hours at 120°F in lard/oleic mixture.	Excellent
Overstoving and double stoving.	Exceptional colour stability

Berger Paints

Quality famous since 1760



Bergercron applied direct to pretreated metal. Photograph of test panel showing bend test and 1 mm. cross hatch at hardness 5H.

POST THIS COUPON NOW!

To:

Metal Finishes Division, Lewis Berger (Gt. Britain) Ltd., Chadwell Heath, Essex.

Please send me more information about Bergercron.

Name .....

Company .....

Address .....

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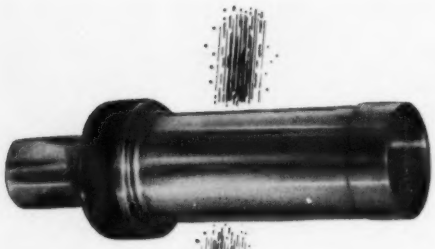
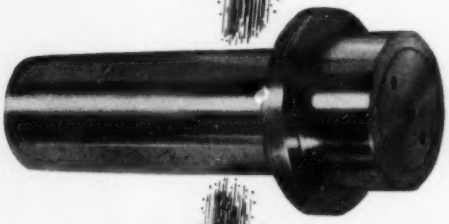


Perfection!



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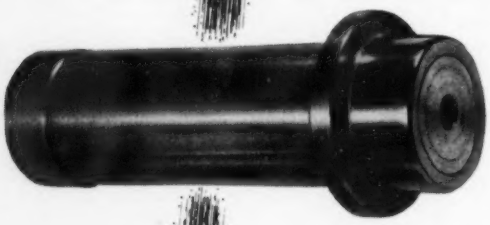
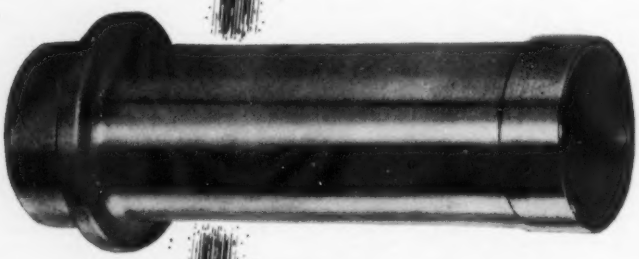


C.T.B NOZZLES



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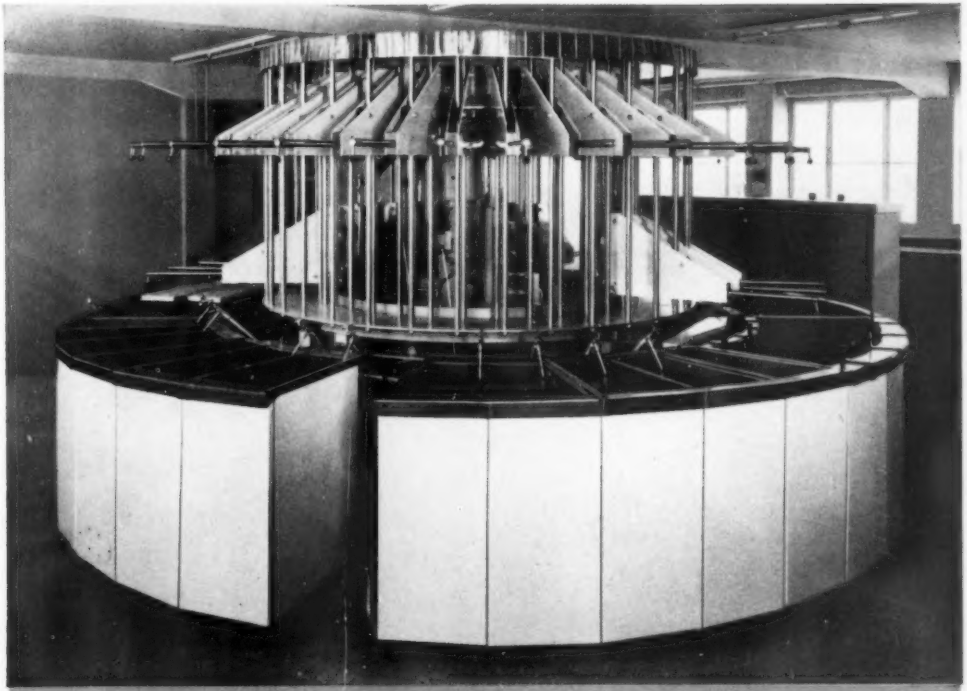

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Perfect finish at your fingertips!

Atlas Copco ECCO 40 —the finest spray gun on the market

Only superlatives will describe the Ecco 40. It's the finest spray-gun you can buy! Suitable for applying any kind of paint or lacquer, it gives perfect atomization whatever the flow or fan width. Pressure loss is negligible and the high velocity and large air and fluid ducts give the gun an unequalled capacity—25 to 30% greater than any other spray gun on the market.

The Ecco 40 is light—only 21 ounces—and couldn't be simpler to operate. It fits snugly into the hand so that fluid and fan controls can be adjusted with a flick of the thumb and the interchangeable paint and air connecting nipples can easily be connected to different standard threads.

WRITE FOR THE LEAFLET

Leaflets and literature describing the Ecco 40 spray gun and the Atlas Copco range of paint spraying equipment are readily available on request from your local Atlas Copco company or agent or from the address below.

SALES AND SERVICE IN NINETY COUNTRIES

Atlas Copco is the world's largest organisation specialising solely in compressed air equipment. Wherever you are, the international Atlas Copco group offers expert advice on the selection of equipment and provides a complete after sales service.

The Ecco 40 is easy to maintain. The streamlined design hinders paint from congealing on the exterior; as there are few parts, stripping and cleaning are swift and simple. Teflon packings are used to prevent paint leakage.

Designed chiefly for spraying with pressure feed from a container or by suction feed from a cup, the Ecco 40 can also be adapted for gravity or pressure feed from cups.

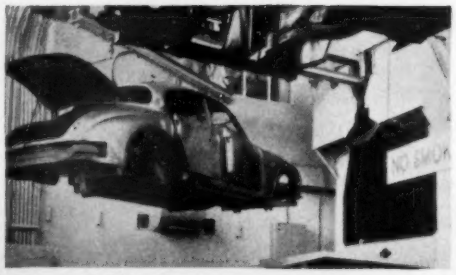
Here's an unbeatable hot-spraying combination—the Ecco 40 pressure fed from an Ecco hot-spraying unit. The result: a better finish in a shorter time! The required viscosity is obtained by heating with water, which gives a constant temperature. You save paint and solvent—and use less air.

Atlas Copco

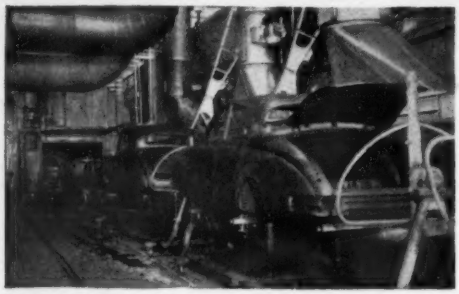
puts compressed air to work for the world

ATLAS COPCO AB, STOCKHOLM 1, SWEDEN

Rustproofing of the Body



The Growth of an Enterprise



The Paint Shop

"The West Midlands Gas Board kept their target with this new main to an extent which could not have been bettered by any other commercial organisation!"

The roots of the Jaguar organisation extend back for 38 years, when the present Chairman and Managing Director, Sir William Lyons, then Mr. Lyons, in company with a partner, started a modest factory for the manufacture of Swallow sidecars at Blackpool in 1922. By 1928 the Swallow Company had outgrown two factories and in that year moved to a large factory in Coventry. It was from that factory in 1931 that the first complete car made by the Company to have an identity of its own emerged under the name S.S. (Swallow Sports). In 1933 a new company was formed—S.S. Cars Ltd.—the original Swallow concern remaining in being, and in 1935 the first Jaguar saloon was introduced. Two-seater sports cars were added to the range—the Company being the first to produce a 100 m.p.h. regular series production car at a price of under £450. The War, of course, called a halt to the progress of all motor car manufacture and in 1945 the newly named Company — Jaguar Cars Ltd.—set out with the primary object of raising the prestige of the British Car Industry abroad. It did this by combining exceptional technical design and high performance with near-perfect finish. In the years following the War, official Jaguar teams and private owners have won over 80 major international races and rallies and acquired hundreds of successes in the lesser national and international events. The fact that the Jaguar name has been blazoned across the World is confirmed by the fact that in the post-war years 56.9% of Jaguars went abroad, and no less than 48.2% captured the American market.

The total number of workpeople employed in the Jaguar factory is now 4½ thousand and the Company occupies a 78-acre site in Coventry. Open competition successes have placed the efficiency of the power and transmission systems of the Jaguar beyond reproach, but for the average motorist a high standard of finish which combines excellence in appearance with almost complete resistance to corrosion is just as important. The visitor to the factory cannot help but be impressed with the care taken on the finishing lines. A newly installed plant takes the car body on a huge spit through water rinsing, cleaning, phosphating and a chromic acid rinse. After drying, the body is dipped in a slipper paint bath to protect the innumerable nooks and crannies underneath, and then the surfacer coats are applied. Thus every car is adequately protected from corrosion. The protected bodies now pass on over-head conveyors through the remainder of the plant. The first operation is to spray sound deadener and sealing composition on the under side and

then come rubbing down, the application of the sealing coat, and the final colour coats. During the whole of this time the car body remains on its mobile spit.

The complete sequence of finishing operations is as follows:—

1. Remove any oil from body.
2. Metal preparation and fittings.
3. Apply catalyst filler to holes in the lead loaded areas.
4. Transfer body to overhead dual conveyor.
5. Clean and phosphate body in 6-station spray phosphating plant, using low temperature process.
6. Dry in dry-off oven—temperature 320°F.
7. Apply synthetic stopping as required.
8. Tac rag.
9. Slipper dip lower half of body.
10. Drain and flash off.
11. Spray primer surfacer single and double header coats using Ecco No. 30 spray gun.
12. Stove for 45 minutes at 275/280°F.
13. Unload body from conveyor on to mobile spit.
14. Spray bituminous compound for sealing and sound deadening on the underside of the car and in the engine compartment.
15. Remove sound deadener overspray.
16. Wet wipe—320 paper.
17. Spin body to remove surplus water—dry off in oven at 265°F
18. Spray one double header coat of sealer using Ecco No. 30 spray gun.
19. Bake sealer coat 30 minutes—270/286°F.
20. Wet face sealer coat with 400 paper. Spin body to remove surplus water and sponge down.
21. Dry off in oven ten minutes at 225/230°F.
22. Vacuum clean trestle.
23. Tac rag interior surfaces and exterior.
24. Spray door shuts, engine compartment and boot interior in colour.
25. Remove overspray from exterior, solvent wipe and tac rag exterior of body complete.
26. Spray one single and one double header coat of colour.
27. Bake colour coat 45 minutes at 250/265°F.

The Final Line

Throughout these sequences the drying and stoving time schedules are vitally important. The gas-fired ovens used in operations 6, 12, 17, 19, 21 and 27 are held under a strict automatic temperature control by control pyrometers which instantly adjust the air and gas flow to ensure that the correct temperature is maintained.

Town gas is also employed in other parts of the plant for numerous heat treatment purposes including annealing and carburizing. These heat treatment operations are, of course, also vitally important to the ultimate performance of the gearing and transmission. The correct time/temperature schedules to introduce the necessary metallurgical structure in the metals are also achieved by control pyrometers in the furnaces, regulating the air and gas supply according to requirements.

When the recent extension of the Jaguar factory was completed it was a formidable task of reorganisation, because it was essential that production disturbances should be a minimum.

Such was the increased demand for town gas that the West Midlands Gas Board had to lay on a new high pressure gas main. Executives of the West Midlands Gas Board and Jaguar Cars collaborated closely to maintain the target thay had set themselves, and those at Jaguars' commented, "*The West Midlands Gas Board kept their target with this new main to an extent which could not have been bettered by any other commercial organisation!*"

Motor car manufacture is, of course, but one of the thousands of trades, professions and occupations which employ town gas in those production techniques where an automatic heat service is a paramount necessity. Each of the twelve Area Gas Boards throughout the country employs specialised industrial gas engineers, who have studied the many varied techniques of industrial gas application. Industrial gas executives from each of the Area Gas Boards meet regularly to inter-change experiences and discuss new problems which have been presented to them. The result is that any industrialist making an approach to any Industrial Officer at any Area Gas Board has presented to him immediately an overall picture of the latest techniques of heat control, based upon progress made throughout the country—and in addition, the Industrial Gas Information Bureau keeps in close touch with developments in industrial gas usage throughout the World.

Scottish Gas Board, Edinburgh
Northern Gas Board, Newcastle-upon-Tyne
North Western Gas Board, Manchester
North Eastern Gas Board, Leeds
East Midlands Gas Board, Leicester
West Midlands Gas Board, Birmingham
Wales Gas Board, Cardiff
Eastern Gas Board, Watford
North Thames Gas Board, W.8
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South Western Gas Board, Bath

The Gas Council, 1 Grosvenor Place, London, S.W.1

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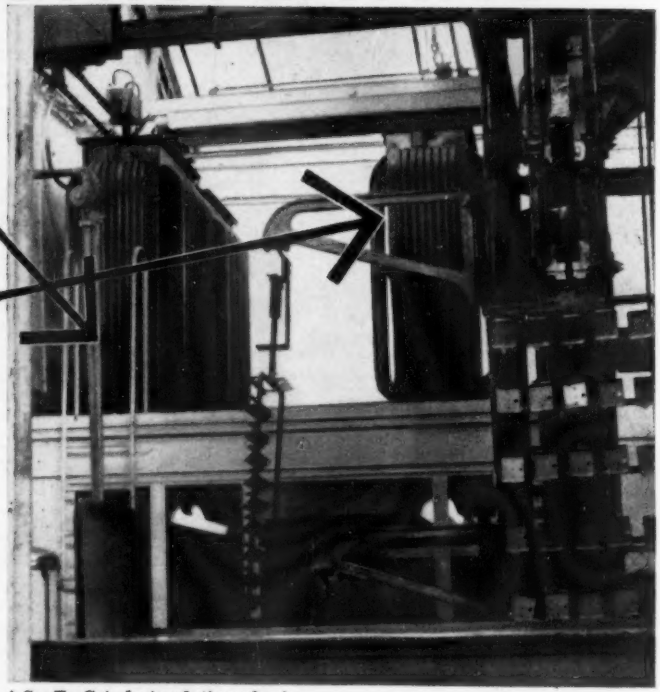

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8	1,500
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A SenTerCet electroplating plant installed in a plating and etching shop.

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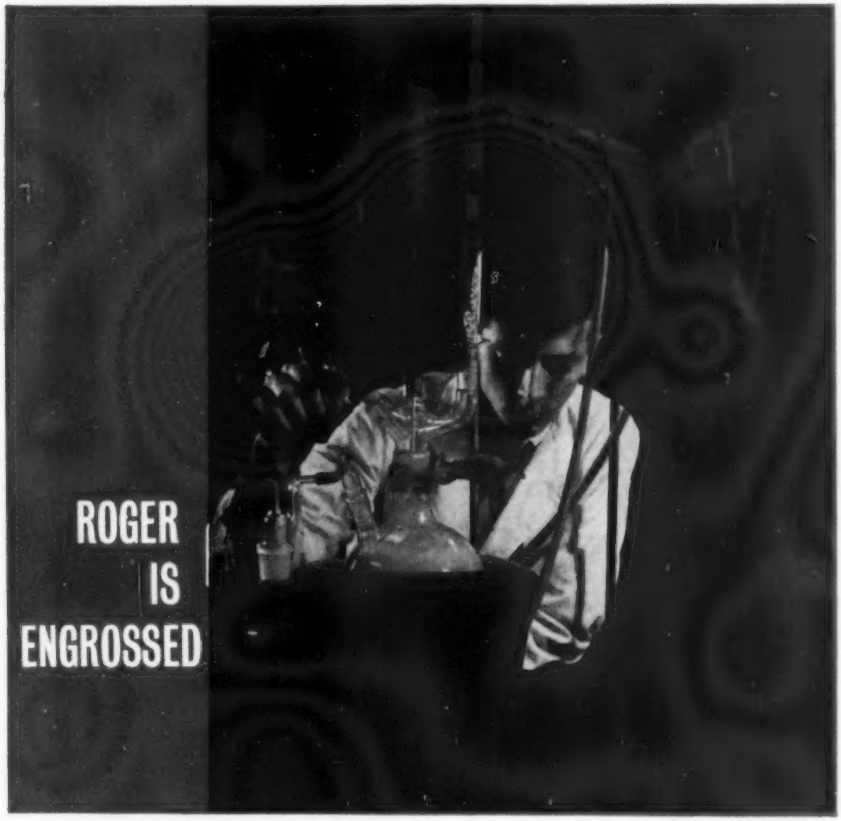

His name is Roger Armistead.
He is working in the new, well equipped £200,000 Research Laboratory of Laporte Titanium Limited on the Humber Bank at Stallingborough, near Grimsby.
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A moist cream coloured powder, readily soluble in water, consisting of alkaline detergents, organic surface active agents, hydrocarbon solvents and rust preventatives. A medium to heavy duty cleaner for ferrous and non-ferrous metals as a spray cleaner

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A dry dust free mixture of buffered alkalis, water softening agents and low foaming wetting agents, a mild, medium duty alkaline cleaner for aluminium, zinc alloy, brass and ferrous alloy base metals, applied by spray or immersion.

Alkaline Cleaner No. 565

A dry tan coloured mixture of alkalis, water softening agents and high foam wetting agents. It is a heavy duty cleaner, suitable for immersion cleaning of ferrous metals and alloys.

Paint Stripper No. 602F

Supplied in powdered form, 602F is readily soluble in hot water, a powerful inexpensive paint stripper. Many types of paint and lacquer can be stripped including some which are not removed by conventional alkaline strippers.

* Investigate the full range of Efco cleaners and processes.

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. . . in minutes . . .

Where high-speed-drying enamels are called for — as in the case of the Dumbo loading system units — these special Luxol finishes offer the immediate answer. Outside the scope of both the cellulose and petroleum regulations, Luxol Quick Drying Enamels are tack free in less than 30 minutes . . . hard dry overnight . . . and force drying when necessary in 30-40 minutes. Available in all shades . . . drying with high gloss finish, Luxol Quick Drying Enamels are extremely durable, resist chipping extremely well and withstand oils and greases superbly. A wide variety of uses from toys to electrical and scientific instruments; furniture and agricultural implements: Luxol Quick Drying Enamels are first choice for the finest finish.

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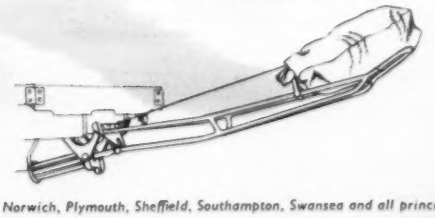

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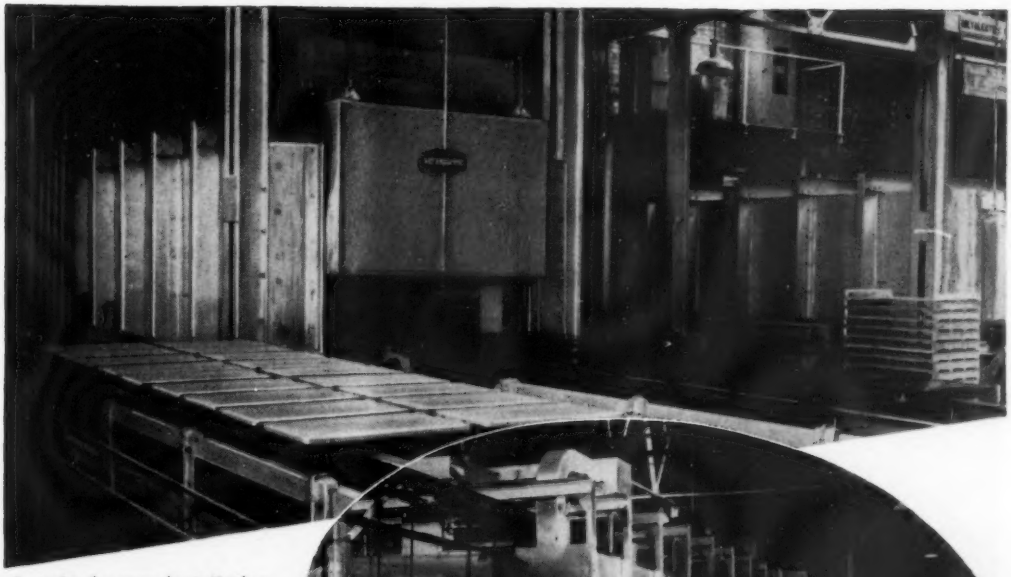
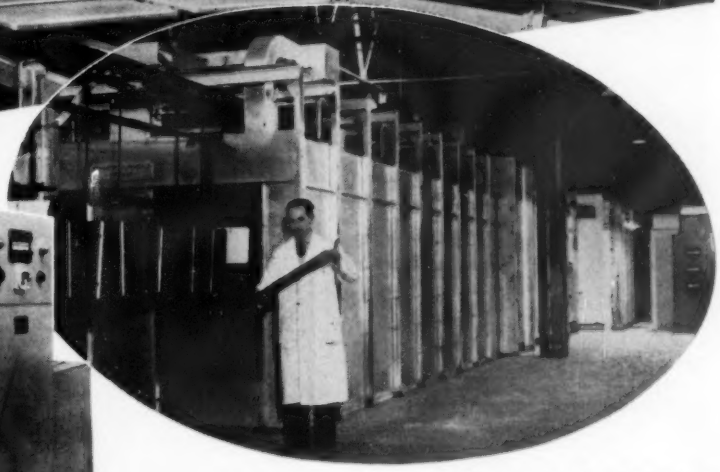


A twin furnace installation for fusing. The plant includes a charging machine and a continuous drying oven.



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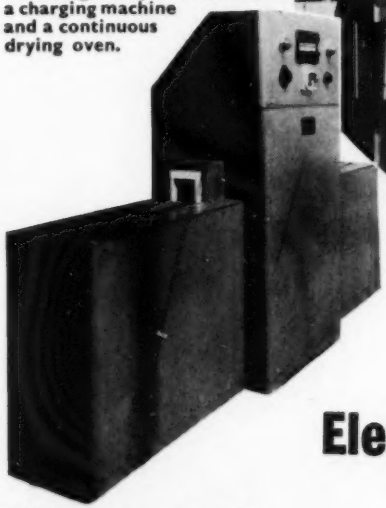

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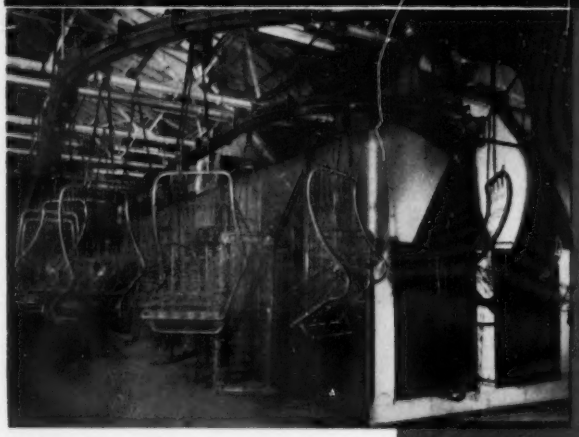

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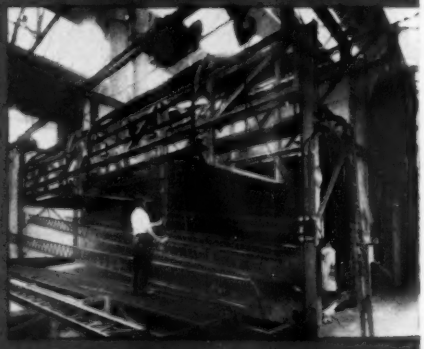
Illustration right: A direct gas fired, air circulated camel-back conveyor stoving oven for metal building sections up to 40 feet wide × 7'6" deep.

Photograph below: Six-stage cleaning and phosphating plant and dip painting equipment for motor panels. Complete installation includes paint dip and dump tanks, paint circulating and storage equipment, drain tunnel, etc.



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metal finishing Journal

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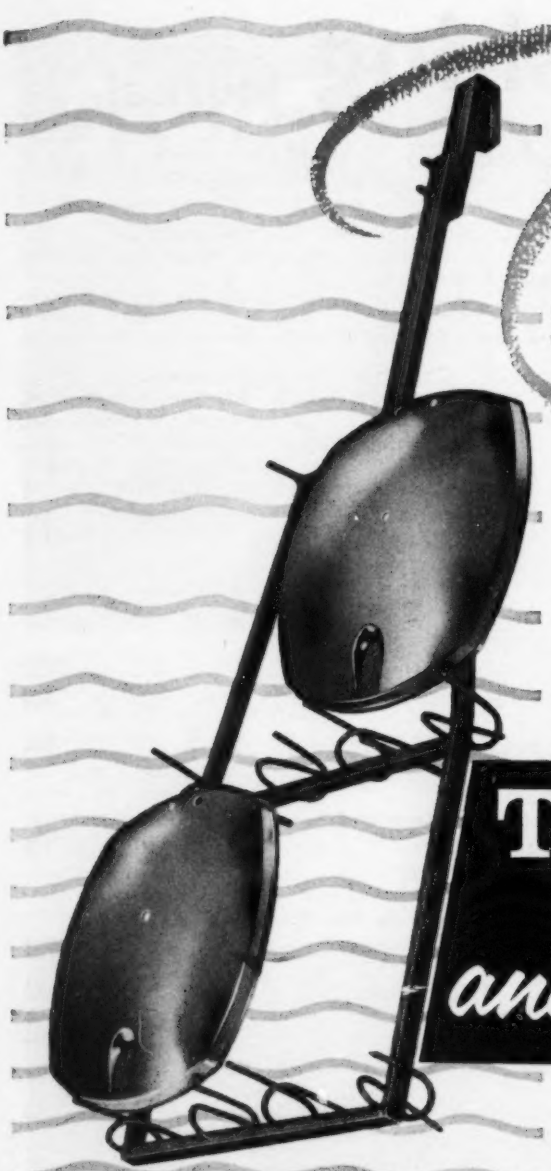

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DOWN THE DRAIN

THE committal of an object to the general sewer, whether it be money down the drain or the baby down the plug-hole with the bath water, is usually taken as being a final and irreclaimable loss — a relegation to some unknown bourne from which nothing ever returns.

Nevertheless drains do not lead to some vast bottom-less pit into which the outpourings of some tens of millions of bathrooms, to say nothing of the incidental arisings from many thousands of factories, vanish for ever from the sight of man. Visual evidence of the fact that this pit is far from bottomless has been readily available in many parts of the country where our rivers have been decorated with massive layers of foam arising from the vast quantities of synthetic detergent poured into their streams in the course of a normal day's washing. This has only been a further phase in a long series going back to the Industrial Revolution, of use being made of drains and water courses as convenient dumping grounds for any fluid or semi-fluid materials of industrial or domestic origin of which it was required to dispose. The present insanitary reek of many once limpid streams and pleasant rivers is the result of excessive indulgence in this practice.

A growing public conviction that this trend was an undesirable one has led to the enactment of a number of pieces of legislation aimed at its control, and already there are signs that the degree of pollution is abating. Local authorities now have substantial powers of control over what may and may not be emitted to their sewers by industry (the housewife, for reasons which are manifest, can be less easily regulated).

The emergence of new materials and processes for industrial and domestic use continually poses new problems for those who have responsibility for operating sewage treating systems (witness the synthetic detergents already referred to above). The variety of materials and of their affect on treatment processes is very considerable and the problem of dealing with them has justified the establishment of a research laboratory operated by D.S.I.R. devoted to their investigation and solution. Now comes news of the inauguration of an exhibition devoted to effluent and water treatment to be staged in conjunction with a Convention on the subject.

The metal-finishing industry, and particularly those in it concerned with electroplating, is vitally concerned with the question of effluent treatment, in view of the considerable use which is made of highly poisonous chemicals such as cyanide and also of the salts of heavy metals, all of which, unfortunately, react adversely on the biological processes on which so much of water purification depends. The fact that concentrations of cyanide as low as ten parts per million are regarded as a maximum, at least by the London County Council, was highlighted recently in a Court case fought largely as a test case by one of the best known firms of jobbing platers in the London area and reported in the July issue of Metal Finishing Journal. The fact that complex cyanides of the heavy metals prove less susceptible to breakdown by accepted effluent treatment processes renders the task of the conscientious electroplater seeking to observe the regulations even more difficult and costly. It is to be hoped that this new Exhibition and Convention will point the way to achieving the desired reduction in pollution without imposing an unfair economic burden on the industry.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

CONFIRMING THE OBVIOUS

IT sometimes happens in the technical field, that the "obviously" correct procedure may not be the right course at all. Hence the need for experiment. At a recent meeting on plating quality, the importance of regular cleaning in improving the durability of chromium plating was stressed several times. Of course, a certain amount of cleaning is necessary, and this is, in fact, usually carried out, but has anyone actually proved experimentally that frequently cleaned chromium plate lasts longer than plating cleaned only rarely? Certainly, the optimum frequency of cleaning for maximum durability has never been determined. In fact, there is some evidence that thorough cleaning accelerates corrosion, since it is well known that in carrying out the salt-spray test it is essential to clean the metal carefully beforehand, in order to avoid misleading results.

A few years ago, some investigations were carried out on the painting of steel, in order to demonstrate the apparently obvious fact that steelwork should not be painted when the surface was wet with rain. A series of panels, some of which were wet when painted and others carefully dried, were exposed to weathering tests. The results showed that contrary to expectations, no difference was found between the two series. The authors of the paper, however, cautiously remarked that this should not be construed as a recommendation to paint wet steel!

It is unwise to take anything for granted in the finishing industry—or anywhere else for that matter.

HOW MUCH?

A CORRESPONDENT in a scientific journal last month (August) voices an old complaint that hardly any items of equipment advertised quote a price. He wants to know why this is the case, since to him the price of the article is the most significant piece of information he requires.

Of course, a case can be made out for not pricing advertisements of this type. In the first place, it is often argued that this would be giving information to competitors, although, in fact, most manufacturers are soon aware of the prices of competitive products in any case.

Perhaps a more valid reason is that if a price is given the potential customer may not wish to proceed further if it seems too dear to him. When he enquires to discover the price, however, a salesman can subsequently call in order to persuade him that the article is worth the money, and hence turn the enquiry into an order.

There does not seem to be much solid information to go on as to the merits or demerits of quoting prices, except that it seems to have become traditional not to do so. There is scope for some market research here, in order to assess the relative advantages and disadvantages of the two systems. One thing is certain, however; most readers would like to see more prices quoted in trade advertisements, and it is not immediately obvious how doing so could damage the interests of the advertiser.

"BREEDER" SOLUTIONS

THE atomic reactor which produces more fuel than it consumes appears to have its counterpart in the metal-finishing industry, since a recent paper on chemical polishing refers to a solution the long life of which has proved an embarrassment rather than an advantage. It appears that it is possible to keep it working simply by adding nitric acid and water for an almost indefinite period, so that eventually the poor user has more electropolishing solution than he knows what to do with.

This is a new angle, as the problem with most solutions has been that they do not last long enough. There seem to be several possible ways of resolving the dilemma. One is to go into the business of supplying chemical polishing solutions by selling the self-created surplus; the other is to expand the business at such a rate that the extra solution is fully utilized. Alternatively, work which drags or cups out a lot of solution should be sought to help things along.

Apart from changing to a less efficient bath, it is, I suppose, always possible to dump a proportion of the solution periodically—*via* an efficient effluent-treatment plant, of course.

WHAT'S IN A NAME?

THE first conference in this country on Ergonomics—the new tripartite study which aims at achieving maximum human efficiency with minimum stress—is to be held in London at the end of this month. The writer has been trying to achieve this all his life, but is gratified to learn that it now has a name!

ZINC COATINGS ON IRON AND STEEL

6 — Applications of Zinc Coatings

A Survey

by A. K. PARKER, M.A.
in collaboration with the Zinc Development Association

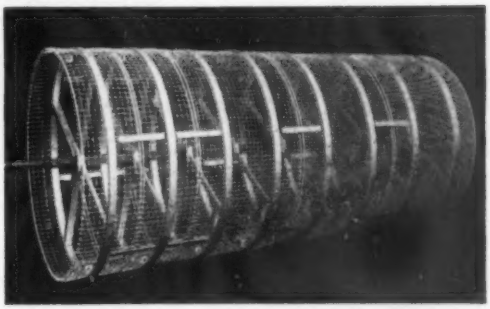
(*Continued from page* 150, *April*, 1960 *issue*)

THE field in which zinc coatings are successfully used to protect iron and steel goods from corrosive attack is a very wide one, and it is quite impossible in a series of articles of this sort to do more than indicate their scope by listing a few examples from different industries.

Zinc coatings are used to protect articles of all shapes and sizes, from pipelines several miles long, for example, down to the humblest nail or washer. By suitable choice of coating processes, zinc may be applied with equal reliability to simply shaped articles, such as dustbins, whose life is often one of continual abuse, and to delicate instrument parts made to close tolerances. Again, different types of equipment and plant have been developed which make possible both the individual treatment of single articles and the continuous zinc coating of mass-produced goods and semi-finished products, such as sheet, strip, tube and wire.

Zinc-coated goods are to be found in service on land, in and on the sea and in the air in all climates ranging from the arctic — many of the hot-dip galvanized radar towers forming part of the American hemisphere defence programme are sited in the Canadian arctic — to the tropics, where galvanized corrugated sheet is one of the commonest building materials.

Examples of the wide range of applications have been classified under the following fifteen headings : agriculture, aircraft, buildings, bridges and tunnels, defence equipment, domestic and institutional equipment, electrical and electronic equipment, gasworks, industrial plant, marine, railways, road vehicles, ventilation equipment, water-supply equipment and miscellaneous.



Agriculture

It is well known that members of the farming community are among the hardest working in the country — they are left with little time to carry out more than the minimum amount of maintenance on their equipment and so must choose items which can be expected to give a long service life with very little attention. It is not surprising therefore to find that many farm implements are protected against the ravages of the weather by a heavy zinc coating, usually applied by hot-dip

Fig. 32.—(right) The galvanized sheet on this Dutch barn has been painted with calcium plumbate-based paints.
Courtesy Associated Lead Manufacturers Ltd.

Fig. 33.—(above, right) A galvanized rotary fruit grader.

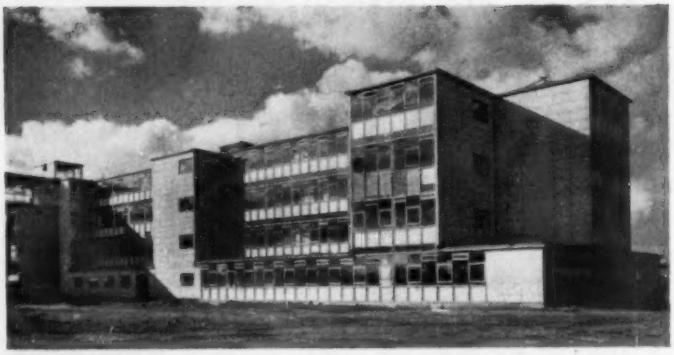


Fig. 34.—The structural steelwork of this Birmingham school was hot-dip galvanized.

galvanizing. Examples include buckets, bins for corn and dry animal feeding stuffs, feeding and drinking troughs, wheelbarrows, laying boxes, incubators and other poultry appliances and wheeled bins for liquids. The rotary fruit grader shown in Fig. 33 is a further example.

Many tons of galvanized wire and galvanized netting are used by the farmer to retain his livestock. Many farm buildings are roofed with corrugated galvanized iron; these range from buildings used for housing livestock to the Dutch barns used for storing crops. Silos, too, are frequently constructed from corrugated galvanized sheeting. Also, of course, many farms have their own water supplies, often with a wind-driven pump mounted on a zinc-coated tower and distributing the water through small-diameter galvanized pipes.

Aircraft

Although steel is too heavy a material to be used for structural purposes in aircraft, zinc-coated steel does manage to find its way up into the air. An example is the zinc plating of hollow steel propeller blades[1], which is carried out by a special process* which enables the thickness of the coating to be varied locally over the surface of the propeller. In this way, the propeller may be exactly balanced when it is first made and, later on, when it has suffered the inevitable damage from dust and stones blown up from airfield runways, the process can be used to repair it.

Much of the electrical and radar equipment in aircraft is zinc coated in the normal course of manufacture; such equipment is mentioned in detail under "Electrical and Electronic Equipment."

Buildings

The use of zinc coatings to protect farm buildings against corrosion has already been mentioned but this is far from being their only application in building construction. Indeed, the building trade is one of the largest users of zinc-coated steelwork.

* Brush plating, in which the zinc is deposited from electrolytes held in absorbent materials attached to portable electrodes.

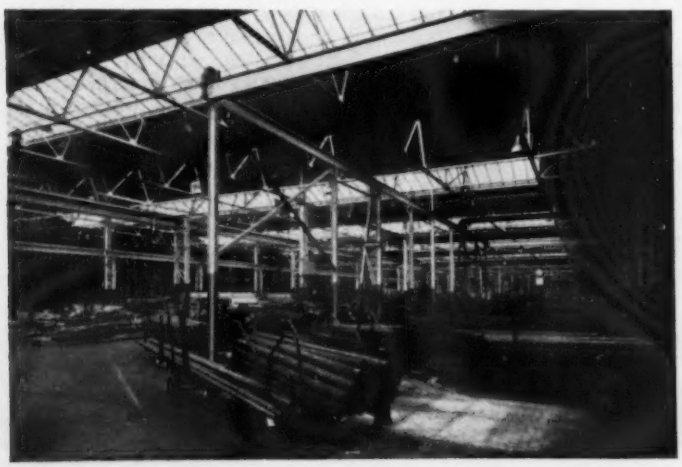


Fig. 35.—The structural steelwork and trusses in this factory have been painted with zinc-rich paint. Courtesy Drynamels Ltd.

Fig. 36.—(left) Miscellaneous galvanized articles.

Fig. 37.—(below) Zinc spraying the chain links for the Menai Straits bridge. Courtesy Schori Division, F. W. Berk & Co. Ltd.

In large modern buildings, the structure is usually supported on a steel framework which is completely encased in brickwork or plastic, metal or glass panels. As this framework is often quite inaccessible once the building is completed, it is only commonsense to see that it is adequately protected against corrosion caused by condensation etc. Zinc coating by hot-dip galvanizing before erection or by zinc spraying, either in the factory or on the site, is therefore specified for the framework of many new buildings. Zinc-rich paints are also useful here. If the framework is accessible, zinc paints provide an excellent way of renovating the framework of old buildings.

Corrugated galvanized steel sheet is often used for the roofs and sidesheets of factory buildings. One of the largest applications of corrugated galvanized sidesheeting is on the hot-strip mill of the Abbey Works of the Steel Company of Wales, the biggest mill of its kind in Great Britain. Strong protective measures were necessary on account of the presence of blast-furnace and other corrosive gases in the atmosphere. Zinc-coated steel is also used in factories for the construction of partitioning and spray painting booths, while acoustic ceilings, Scandinavian tiles and corner beading are often made from the same material.

Steel window frames are now adopted as standard for the majority of new buildings and a large proportion of these are given a zinc coating by hot dipping or spraying before they leave the manufacturer ; individual window bars are sometimes sherardized. These treatments ensure that the steel is able to withstand a considerable amount of abrasion and rough handling on its journey from the factory to the building site, on the site itself

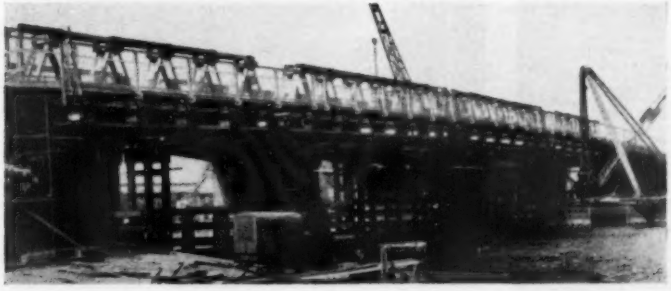


Fig. 38.—The Callender-Hamilton bridge at Walton-on-Thames was hot-dip galvanized. Courtesy British Insulated Callenders Construction Co. Ltd.

Fig. 39.—The 1000-ft. television mast at Mendlesham has been galvanized. This view shows the reduction in area at 800 ft.
Courtesy British Insulated Callenders Construction Co. Ltd.

and while it is being fixed in position. Once fixed, the window frame still has to cope with the vicissitudes of the British climate for a very long service life, often with infrequent maintenance painting. So successfully do zinc-coated windows stand up to these hazards that the relevant British Standard[2] specifies that "all standard steel windows, doors, sidelights, fanlights, coupling members and ferrous components (other than fixing lugs) shall be finished with a protective coating applied by hot-dip or electro-galvanizing, aluminium or zinc metal spraying, or sherardizing."

Outside steel stairways — such as are often intended as fire escapes — railings, platforms and catwalks, both inside and outside industrial buildings, need to be well protected against corrosion as any possibility of collapse may be, literally, a matter of life and death. It is not surprising, therefore, that items like these are often given a substantial coating of zinc, by hot dipping, by spraying or by painting with a zinc-rich paint.

Other exterior features of buildings which are commonly made in steel and zinc coated include gutters and downpipes for removing rainwater, ventilators and a host of smaller items which are commonly called builders' hardware. Whereas the larger items are usually hot-dip galvanized, some of the smaller ones are often sherardized, examples including nails, screws, hinges, bolts, door catches, scaffolding couplings and even sections for making up into window frames. A selection of these items is shown in Fig. 46.

Gates, railings and fences also need to be protected against the ravages of the weather and here again the application of a zinc coating provides one of the simplest ways of prolonging their life. When decorative repainting becomes necessary, the presence of the underlying zinc coating reduces the amount of surface preparation required before the new paint can be applied.

Fig. 40.—The chassis of this television set has been protected by plating with zinc.
Courtesy T.V. Manufacturing Co. Ltd.

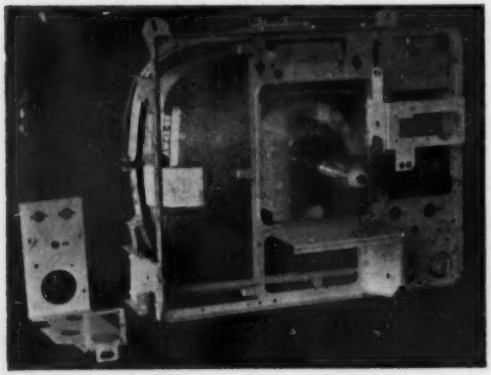


Fig. 41.—Nearly all the steelwork on this dry-cleaning plant has been hot-dip galvanized and painted.
Courtesy Neal & Spencer Ltd.

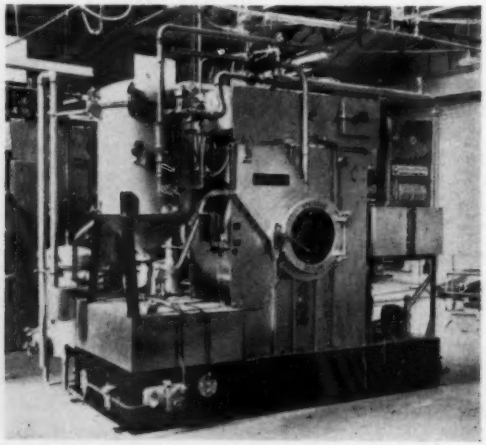
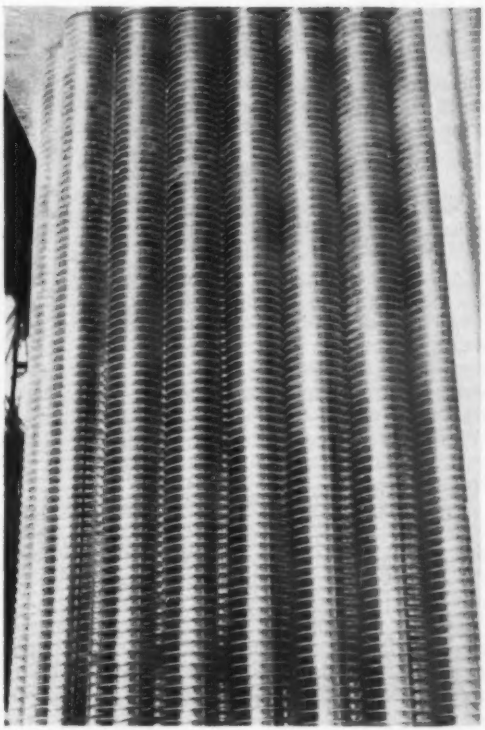


Fig. 42.—A finned cooling unit galvanized after fabrication.



Bridges and Tunnels

Bridges are of many different types and serve many different purposes but the effectiveness of all iron and steel bridges depends upon their being properly protected against corrosive attack, which otherwise eats away the metal and weakens the structural members. For over a century, paint has been used to provide this protection but, with the steady rise in labour costs, increasing use is being made of zinc coatings to give long-term protection on both old and new bridges. Zinc spraying and the use of zinc-rich paints are the only methods applicable to bridges which are already in position, but for new structures galvanizing before fabrication offers a third possibility.

The supporting steelwork on the suspension bridge across the Menai Straits, built over 130 years ago by the great engineer Thomas Telford, was given a zinc sprayed coating 0.005 in. thick in 1939 which, in spite of lack of maintenance during the war years and continual exposure to the elements, was still in excellent condition 15 years later[3]. Other bridges which have been zinc sprayed include the Jubilee Bridge at Barrow-in-Furness, where the severe marine conditions had shown that paint alone was inadequate, and the Oddesund and Villesund bridges in Denmark.

Several of the Callender-Hamilton sectional bridges, which are in service in many parts of the world, have been hot-dip galvanized before assembly. The one shown in Fig. 38 actually lay idle on the site at Walton-on-Thames for 16 years before it was erected and yet remained free from rust. Another example of the use of hot-dip galvanizing in bridge construction is the cables for the gigantic Golden Gate bridge at San Francisco.

Corrugated galvanized steel sheet is sometimes used for the walls and roofs of tunnels and culverts, and many of the larger culverts on the New York State Thruway are lined in this way. Another tunnel which is lined with zinc-coated steel is the 1¾-mile long pipeline which carries water into the hydro-electric power station at Clunie in Perthshire. This tunnel, which is 23 ft. in diameter, was given a coating of 0.004-in. thick sprayed zinc, as well as a bituminous undercoating and two coats of a special black finishing paint, to protect

Fig. 43.—Zinc spraying the hull of a light sea rescue launch. Courtesy Schori Division, F. W. Berk & Co. Ltd.

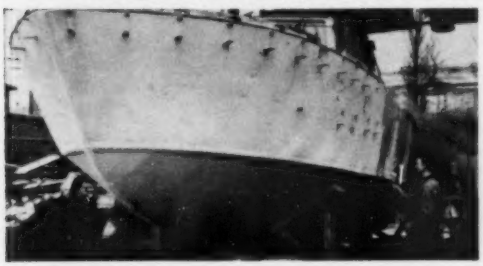
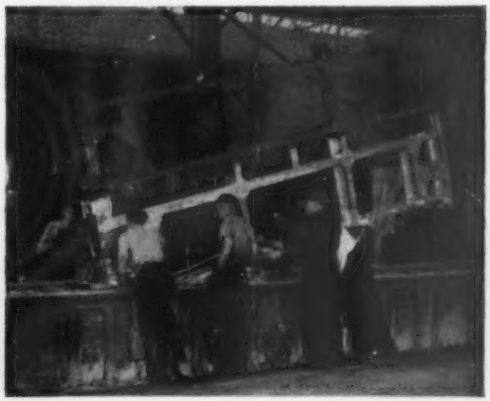


Fig. 44.—A welded underframe of a 13-ton railway wagon being galvanized.



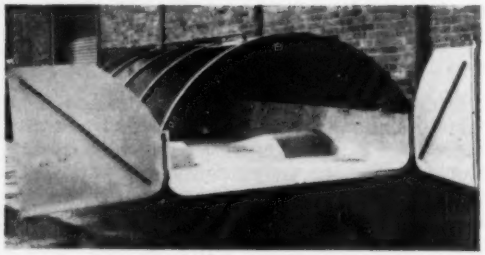


Fig. 45.—A zinc-sprayed refuse vehicle.
Courtesy Schori Division, F. W. Berk & Co. Ltd.

the steelwork against the highly corrosive peaty water which flows through the tunnel now that it is in service.

Defence Equipment

Many items of defence equipment fall into the other categories of zinc-coated articles listed in this chapter, so they will only receive very brief reference here. Many fittings on naval vessels are, like their civilian counterparts, zinc coated to protect them against the corrosive attack of sea-water and marine air ; also the bottom plates of some of H.M. ships are galvanized before being welded or riveted into place. Zinc-coated electronic equipment and the cabinets in which it is housed are used by all three services and military transport vehicles incorporate zinc-coated parts just as civilian ones do.

Cartridge cases are an item of defence equipment which has no civilian equivalent, so it is worth mentioning that the U.S. Navy uses zinc-plated steel for its larger calibre cartridge cases[4], the coating being 0.0002 to 0.0005 in. thick.

Defence equipment often has to withstand extreme climatic conditions and it does, of course, receive more than its fair share of abuse. Hence, the choice of zinc coatings to protect installations which may see service anywhere between the tropics and the Arctic is an excellent tribute to their performance under a wide range of conditions.

Domestic and Institutional Equipment

Hot-and cold-water tanks and cisterns are among the commonest zinc-coated articles to be found in the home. They are invariably hot-dip galvanized, a treatment which seals up riveted joints and applies the zinc coating in one process. The vast majority of the millions of tanks in use give excellent service for well over 20 years before needing replacement, though it is the occasional premature failure which usually attracts publicity.

Kitchen furniture, refrigerator cabinets, washing-machine outsides and electric cookers are often constructed of steel which has been zinc plated or galvanized by a continuous process and then finished with stoving enamel. The underlying zinc surface protects the steel during manufacture and provides a second line of protection during use, preventing the spread of rust under the enamel coating, should this get damaged. Inside the refrigerator, zinc spraying, hot-dip galvanizing or sherardizing is generally used to protect parts such as evaporators and evaporator freezer chests on which large quantities of water condense.

Dustbins, pails and buckets have to take plenty of hard knocks and to resist whatever rotting refuse is put into them — they are invariably hot-dip galvanized (in peacetime, that is). Coal bunkers also need a hard, abrasion-resistant surface, which accounts for the fact they they, too, are usually galvanized.

In the garden, there are zinc-coated garden furniture, wheelbarrows, watering cans and several of the items listed in the agriculture section. Some of these may be zinc sprayed and some galvanized.

Fig. 46.—Some typical sherardized articles.

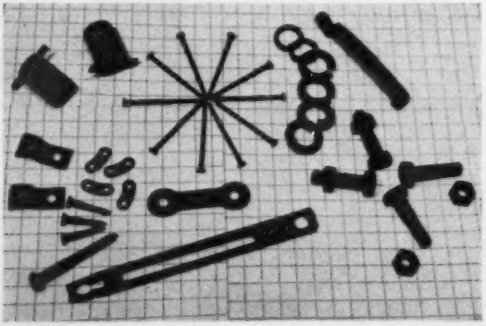


Fig. 47.—A hot-dip galvanized road fender on the London-Birmingham motorway.
Courtesy Armco Ltd.

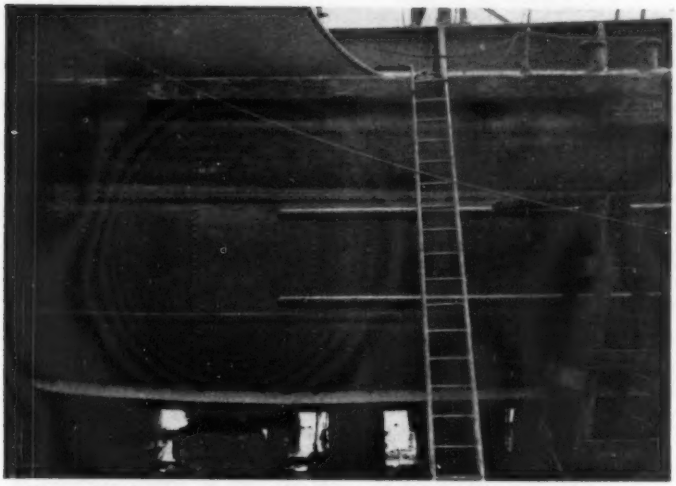


Fig. 48.—The hull of a dredger painted with zinc-rich paint after 1 year's service in the Manchester Ship Canal.
Courtesy Secomastic Ltd.

Zinc-plated steel is an ideal material for the manufacture of desks, filing cabinets, shelving and other office furniture for the reasons mentioned in connexion with kitchen furniture. Zinc spraying is an excellent basis for paint and so is ideal for such items as school and hospital beds and factory lockers which are expected to give a long life and yet withstand a good deal of rough handling.

Electrical and Electronic Equipment

Zinc coating by hot-dip galvanizing or spraying is the standard finish for the heavier outdoor items of electricity distribution equipment and is also widely used for many smaller components.

The use of zinc-coated pipelines for hydro-electic power stations has already been mentioned and there is further scope for zinc coatings in giving long life to the turbines and other parts in contact with water, in both hydro-electric and solid fuel power stations ; two examples are the zinc-sprayed penstocks of the Clunie and Pitlochry power stations in Scotland and the zinc-sprayed pipeline which carries cooling water from the Manchester Ship Canal to the power station at Carrington.

Throughout the world, zinc-coated pylons are used to carry electrical transmission lines, zinc-coated masts carry radio, television and radar aerials and zinc-coated steel structures carry overhead wires for electrified railways. The extra initial cost of the zinc coating is more than justified by the trouble-free life obtained and the ease with which subsequent maintenance can be carried out. In addition, zinc coating is an ideal method of protecting substation structures, outdoor capacitors, transformers and radar aerials from the ravages of the weather, while pole-line hardware is invariably hot-dip galvanized.

Indoors, zinc coatings may be found on electricity meters, switchgear boxes, radar cabinets, cabinets containing ships' electrical gear and on laminations and housings for fractional horse-power motors. Sherardizing also is often used as a finish for steel conduit and conduit fittings and for junction boxes.

Zinc plating, followed by a chromate passivation treatment to prevent the formation of white rust, or by a coating of lacquer, is a common finish for radio chassis and telephone equipment.

Gas Works

Conditions in gas works are fairly corrosive, though perhaps less so than in most chemical

Fig. 49.—A fabricated section of the Volta Bridge after zinc spraying.
Courtesy Freeman, Fox & Partners, and Sir William Halcrow & Partners.

works, except in damp situations adjacent to cooling towers etc., where corrosion may be severe. Methods of protecting the steelwork of gasholders and other structures have been the subject of several investigations and reports. One of these concludes that "zinc coating is probably the one (treatment) most generally suitable" for use in these severe conditions[5]. Zinc spraying is the treatment usually applied to existing gasholders, though fabrication from hot-dip galvanized steel plates is a possible alternative for new plant.

Many of the uses of zinc coating mentioned in the section on industrial plant are equally applicable to gasworks, together with some of those in the marine section. For example, the steel fenders at the wharfside of the Nine Elms, London, gasworks carry a coating of 0.008 in. of sprayed zinc, while the steel screens across the water intake are hot-dip galvanized[5].

Industrial Plant

Industry uses zinc coating to protect its plant, its buildings, its transport vehicles, its ships, its ventilation equipment and many other items. It is in fact one of the biggest users of zinc coatings for protecting steel against corrosive attack by the atmosphere, by sea water and by industrial gases and liquids. Only industrial plant is discussed in this section, the other industrial uses of zinc coatings being mentioned under their separate headings.

Zinc-coated tanks and cylinders are to be found in oil refineries and chemical plants where they are used to store oil and petroleum products, towns gas, chlorine, carbon dioxide and other industrial gases, as well as a wide range of chemicals and water. The zinc coating serves not only to protect the inside of the tanks from attack by the fluids stored in them, but also protects the exterior from attack by the weather and the corrosive industrial atmosphere outside. Also the zinc coating helps to seal the joints between the individual riveted and bolted sections of the tanks. Pipes and valves used in distributing these fluids are also often zinc coated.

Items of process plant, such as gravity sprinkler tanks and reaction vessels can be zinc coated with advantage when they are to contain suitable liquids. Most organic liquids other than certain acids, and all except the strongest alkalis do not attack zinc so that plant used for their storage, transport and treatment can generally be made from steel coated with zinc. More information about the corrosion resistance of zinc was given in Chapter 3.

Trichlorethylene degreasing tanks, germinating drums in breweries and liquid-oxygen evaporators are typical examples of zinc-coated process plant; refrigerating equipment is frequently protected in this way as zinc is highly resistant to corrosion by refrigerants. Because zinc has excellent resistance to soapy water, zinc coatings (which are non-staining) are also applied to the protection of laundry equipment. A further example comes from the production of rayon yarn, in which the zinc coating serves the additional purpose of preventing discoloration of the final product which could result from reaction with the basis metal of the process tanks[6].

The working life of many other items of industrial plant may be lengthened considerably by zinc coating and it is only possible to list a few of them here: cyclone separators, cooling towers and cooling units of all types, petroleum rigs and derricks, conveyors, racks for supporting trays of chemicals in drying ovens and for general storage purposes, machinery guards and so on. In addition, the structural steelwork which supports the various

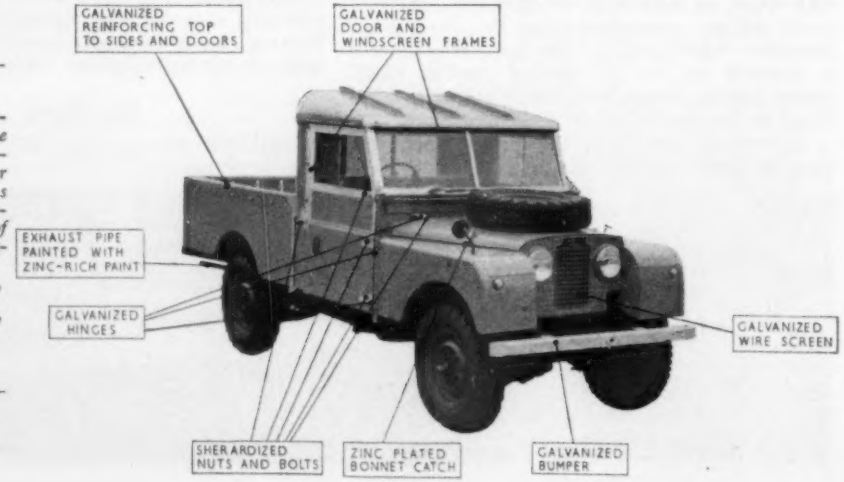

GALVANIZED REINFORCING TOP TO SIDES AND DOORS
GALVANIZED DOOR AND WINDSCREEN FRAMES
EXHAUST PIPE PAINTED WITH ZINC-RICH PAINT
GALVANIZED HINGES
GALVANIZED WIRE SCREEN
SHERARDIZED NUTS AND BOLTS
ZINC PLATED BONNET CATCH
GALVANIZED BUMPER

Fig. 50.—The versatile Land-Rover makes considerable use of zinc coatings. Courtesy, Rover Company Ltd.

Fig. 51.—This kitchen furniture has been made from electro-galvanized sheet and stove-enamelled. Courtesy Redwing Ltd.

items of process equipment must be well protected against corrosion and coating it with zinc has been shown to give outstandingly good results in applications of this sort[7].

Marine

Zinc possesses exceptionally good resistance to corrosion by sea water and by marine atmospheres. It has therefore been very widely adopted by the shipbuilding industry as the ideal coating metal for use on and in ships ; it is also used for protecting structural steelwork on docks and piers, for dam gates etc.

In recent years, the hulls of many smaller ships, particularly below the water line, have been sprayed with heavy zinc coatings. Several of the Tuna clippers operating on the west coast of the United States, tugs for service on both sea and fresh water, oil tankers, barges and yachts are among the many hundreds of zinc sprayed ships in service throughout the world. Other ships incorporate hot-dip galvanized bottom plates in their construction, H.M. destroyers and light vessels, and U.S. Coast Guard patrol boats being prominent examples. Zinc-rich paints give yet a third method for providing long-term protection to the underwater parts of ships ; the Norwegian Royal yacht is a splendid example. Whatever the method of application, the use of a zinc coating increases the period between successive dry dockings, makes painting easier and more effective and reduces overall maintenance costs. As an example of the excellent performance of such coatings, the case of a group of 14 Delaware river barges may be cited. These vessels were zinc sprayed in 1933 and 17 years later it was only found necessary to respray them around the waterline where they had probably been damaged by ice during their rigorous service[8].

Topsides, decks and deck fittings are exposed to the full force of the sea and are, at the same time, exposed to the sun. They are therefore alternately wet and dry, a condition which has been shown to be more severely corrosive than permanent immersion. Zinc finds plenty of applications here, too, though perhaps it has not yet been so widely used as it might for protecting large areas such as the topsides, decks and cabin structures which are relatively easily accessible for maintenance purposes. Deck fittings and rigging accessories are commonly hot-dip galvanized. A few examples include wire ropes, bottlescrews, shackles, eyebolts, steel blocks, chains, stanchions and handrails ; larger items such as ventilators, davits and anchors may be either galvanized or zinc sprayed.

Buoys are also exposed to the elements so it is not surprising to find that they, too, may be zinc coated.

Inside the hull, zinc coatings are applied to another wide range of items. The interior of the hull itself may require protection against corrosion by the cargo ; fuel and water tanks and liquid ballast systems are often difficult of access so that maintenance can only be carried out at infrequent intervals, while the need for protecting fish and bait tanks is obvious. Applying a coating of zinc by spraying, painting or hot-dip galvanizing is the ideal solution to these problems.

The modern ship carries a great deal of electrical and electronic gear and much of this will be zinc coated just as it is on land. In addition there is ventilation and refrigeration plant scattered throughout the ship, so zinc coatings certainly find plenty of applications afloat.

Structural steelwork on docks, piers and slipways is subject to the same corrosive influences as ships at sea, though in addition they require good abrasion resistance. Recently a slipway and some 680 tons of steel piling in the lower reaches of the river Thames have been sprayed with zinc[7] to protect them against corrosion by the tidal waters of the river.

There are several examples of successful zinc spraying on dam gates throughout the world : in the Susquehanna river (U.S.A.), St. Denis canal (France), Panama canal (Central America) and at Centrale de Ryburg-Schwörstadt sur le Rhin (Switzerland). The gates in the St. Denis canal[9] were sprayed with 0.004 in. of zinc as long ago as 1922 and yet were found to be in very good condition in 1939 ; in 1954, 32 years after the original treatment, the steelwork was still in reasonably good condition though the zinc was by this time rather patchy.

Zinc-rich paints have also been used to protect lock gates and they are of course eminently suitable for general use in marine locations, particularly

for renovating existing coatings. They have, for example, been used to patch rust spots on sea-front railings at Brighton[10].

Railways

Railways have to operate in all weathers and most of their equipment is sited in the open so that anti-corrosion measures are of the greatest importance in ensuring safe and economical working with the minimum of maintenance.

On rolling stock, roofs, floors and sidesheeting are often constructed from zinc-coated steel sheet or receive a zinc coating after fabrication ; special channelled steel sheets are used for floors, the channels then being filled with wood, rubber or plastic. A recent experiment has been the hot-dip galvanizing of goods-wagon bodies and underframes in four sections which are then bolted together.

Reference has already been made to the zinc coating of overhead structures carrying electric supply wires on railways and increasing appreciation is being shown of the value of applying zinc coatings to bridges and other structures to ensure a long trouble-free life for them. Railways also use a great deal of galvanized material for track components such as rail spikes and for signal wires and equipment. Zinc spraying, too, is also finding more and more applications in railway service.

Road Vehicles

Zinc coatings are to be found at work in protecting many vital parts of road vehicles against corrosive attack. The floors, roofs and sidesheeting of many commercial vehicles are constructed from zinc-coated steel, together with a large number of road tankers. Zinc coating by galvanizing, spraying, plating or painting with zinc-rich paints has long been established as a finish for exhaust pipes and mufflers, while many smaller parts are zinc plated or sherardized — hub nuts and bolts, engine fittings, sparking plug bodies, door and window mechanisms, bonnet catches, bumpers etc.

The Land-Rover is a vehicle designed for a harder and longer life than most so it is not surprising to find that it carries more than its fair share of zinc coatings. Apart from the main items shown in the accompanying photograph (Fig. 50), the Land-Rover incorporates a large number of sherardized or zinc-plated nuts and bolts and a few small galvanized components.

(*Continued in page* 363)

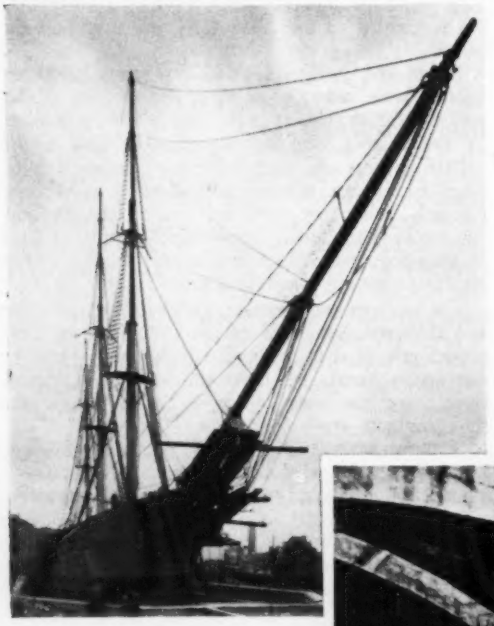


Fig. 52.—(*above*). *The masts and spars on the 'Cutty Sark' have been sprayed with zinc.*
Courtesy Schori Division, F. W. Berk & Co. Ltd.

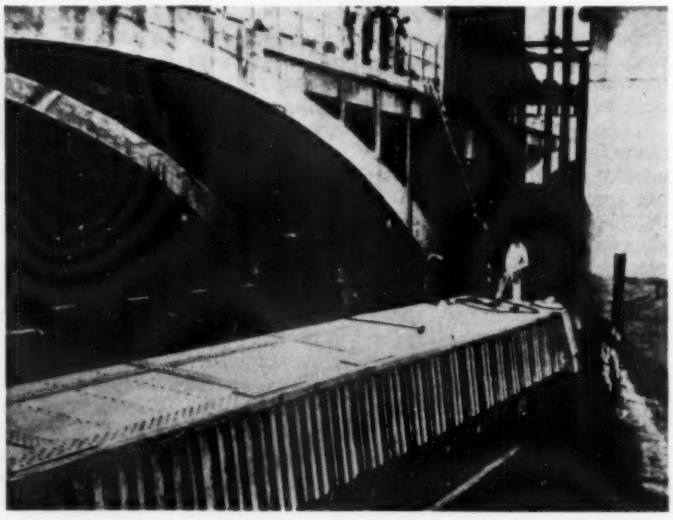


Fig. 53.—(*right*). *Zinc-sprayed lock gates on the Glen Affric hydroelectric scheme.*
Courtesy Schori Division, F. W. Berk & Co. Ltd.

CHROMIUM PLATING ON DIE CASTINGS

Methods of Improving Durability Discussed at Birmingham Colloquium

A COLLOQUIUM on better plating on die-castings, organized by the British Non-Ferrous Metals Research Association in collaboration with the Zinc Development Association, was held at the Edgbaston Botanical Gardens, Birmingham, on Wednesday, 29th June, 1960, at 2.15 p.m. Mr. R. J. Brown, Chief Materials Engineer of the British Motor Corporation and a member of Council of BNFMRA, occupied the chair.

The chairman said the object of the meeting was to discuss nickel-chromium plating, particularly on zinc die-castings. This type of finish had been under criticism for many years both by the user and by the purchaser, and there was no doubt that improvements in plating had been found necessary. These improvements were, of course, dependent on a full understanding of the problems involved.

Over the past few years considerable research had gone into the plating of non-ferrous metals and in particular the plating of zinc die-castings. This had been undertaken in this country by the BNFMRA and in America by the Battelle Memorial Institute, partly under the auspices of the American Zinc Institute. There was much evidence that the greatest benefit could be obtained from the application of a heavier chromium coating than had been the practice in the past.

He invited Dr. Edwards, head of the Metal Finishing Section of BNMFRA to open the discussion.

Dr. J. Edwards (BNMFRA) said the system in question consisted conventionally of zinc basis metal, copper, nickel and chromium. The minimum thicknesses specified in the current British Standard were 0.0003 in. copper, 0.001 in.nickel, and 0.00001 in. chromium.

Considering first the basis metal, it was probable that platers and casters would never really agree on this matter. The various defects, such as flow marks, cold laps, surface porosity, which occurred added to the difficulties of the plater, who suffered as a result from irregular surfaces, pits and blisters which formed a group of defects known as process defects. If these were at all prominent the articles were unacceptable and had to be rejected.

At the BNFMRA the question of process rejections had been studied, determining the cause of the defects and analyzing their frequency. The results of this work had been presented in a paper to the International Die Casting Conference earlier in the year. The BNFMRA had also produced a development report consisting largely of photographs of various defects with photomicrographs of cross-sections showing their origin and a brief commentary to assist in diagnosing the trouble.

The question arose of how far the presence of defects in the die-casting surface influenced the service performance of the plated article. It was clear that some defects could lead to rapid breakdown ; for example, superficial porosity gave rise to a pit in the coating which usually penetrated through the whole thickness, so that corrosion of the zinc began almost immediately in service. If, however, there were more than a few such defects the article would be rejected, whereas if just the few remaining gave rise to blisters in service their effect was not usually important.

That conclusion had not been acceptable to all platers, and the BNFMRA had compared pressure die castings with similar castings made in evacuated dies, with gravity castings and with rolled sheets of zinc alloy. They found that variations in the method of fabrication had no detectable effect on the performance of copper + nickel + chromium coatings applied to them. In the case of the die-castings they had also recorded the position of all minor surface blemishes present whether due to casting or to plating defects and had found again that they made no significant contribution to the breakdown of the specimen as a whole. Even specimens deliberately plated by unsuitable techniques had been undistinguishable from properly plated samples after less than a year's exposure at Euston.

If the coating were very much improved, so that only very slight corrosion developed in the absence of process defects, these would clearly have a more significant contribution to make.

The Battelle Memorial Institute, claimed that this actually occurred on die-castings plated with duplex nickel and thicker-than-normal chromium. The data related exclusively to accelerated corrosion tests, but using both CASS and Corrodkote tests it was found that almost all the corrosion blisters produced were associated with casting defects.

The prime purpose of the copper deposit was to protect the die-casting against the nickel plating solution, which would otherwise attack it. Within reasonable limits they had found that variation in the thickness of copper had no effect on corrosion resistance.

It used to be thought that the principal factor which determined corrosion resistance was the porosity of the nickel deposit. That view was no longer held, it being generally believed that deposits of the order of 0.001 in. in thickness were normally free from porosity. They did, however, suffer corrosion under any discontinuities in the chromium top-coat such as pores or cracks. It was necessary to consider what properties of the nickel deposit influenced its resistance to penetration.

Probably the most important was thickness. In the experience of the BNFMRA the thickness at which further improvement became uneconomic had not yet been reached, but in their recent exposure tests using thicker than normal chromium deposits they had found an improvement with increase in nickel thickness not only between 0.0006 in. and 0.001 in. but also between 0.001 in. and 0.0014 in.

The use of bright nickel was sometimes blamed for the poor performance of post-war plating, but in exposure tests on steel they had detected no significant difference in overall performance among various kinds of bright nickel, buffed semi-bright and dull nickel. An important series of tests in America had shown little difference in industrial atmospheres but a substantial advantage for dull nickel in marine atmospheres. Some of the discrepancies arose from a variation in the pattern of attack on chromium-plated bright nickel and buffed dull nickel. The bright nickel tended to be attacked more vigorously at fewer points than the dull nickel and so in the early stages of the test, or even after a long time in a mild environment, it seemed worse than dull nickel, but when corrosion was considerable the difference was small and might even be reversed.

At one time old and contaminated bright nickel solutions were thought to yield less corrosion-resistant deposits, but after thoroughly studying this aspect they had been unable to detect any change whatever in the performance of bright nickel deposits as the solution from which they were obtained was aged.

In one sense it was true to say that bright nickel was less corrosion-resistant than dull or sulphur-free semi-bright nickel. When samples were immersed without a chromium covering in various corrosive solutions the bright nickel corroded faster. When, however, these deposits as single coatings were covered with a top-coat of chromium, their rate of corrosion was so much influenced by the presence of the chromium that the differences in many atmospheres were small. When both kinds of deposit were used together, however, one on top of the other, as in duplex nickel, the situation arose where one could corrode in preference to the other. This was the basis of the improved corrosion resistance claimed for duplex nickel deposits consisting of a layer of levelling semi-bright nickel free from sulphur followed by a layer of sulphur-containing bright nickel.

There were some apparent inconsistencies in exposure data on the relative performance of duplex and bright nickel. Harshaw and Battelle had demonstrated advantages for duplex nickel, but Udylite in some of their tests had found only a very slight advantage in static exposure on their roof, and no detectable difference in mobile tests on steel and zinc alloy panels exposed on the front of automobiles. The BNFMRA tests had been very limited, but they had not yet been able to establish any clear advantage for duplex nickel. In less corrosive conditions there were indications of improved performance. Its use could be justified on other grounds, particularly on steel and on die-castings. It showed, for example, better levelling power and higher ductility than the conventional single layer of bright nickel.

The chromium deposit was the thinnest in this system, but it was probably the most important. It appeared to be highly resistant to corrosion in most atmospheres, but it was not usually completely continuous. With a porous chromium deposit the nickel exposed at the base of each pore corroded when the surface was covered with a film of moisture in a service environment. Corrosion was apparently electrolytic, with the nickel anodic and an area of chromium around the pore functioning as cathode. The maximum diameter of such an individual cell might be only a few millimetres. If the pores were wide apart the cells did not interact and the rate of corrosion at each pore was independent of the number of pores. If, however, the porosity was very much higher, perhaps of the order of hundreds or even thousands to the square centimetre, the pores competed with each other and the rate of corrosion at each pore was determined largely by the limited area of chromium available to it as cathode. Whereas pits grew very rapidly under isolated pores, they grew more slowly when the pores were very close together. Penetration to the basis metal, causing blistering in the case of zinc die-castings, normally occurred fairly rapidly, therefore, but when the porosity was very high it

took much longer. Undercutting of the chromium, however, occurred rapidly in this case.

When the discontinuities in the chromium were cracks, corrosion of the exposed nickel again took place. Since the crack was extended in one direction, the area of chromium which could function as cathode to a small element of a crack was much smaller than in the case of a pore, so that corrosion under cracks was generally slower.

In some deposits the crack pattern was invisible to the naked eye, and the slight loss of lustre which this caused in the freshly-plated surface was barely perceptible. The nickel corrosion product stained the surface, but the stain was readily removed. After a time undercutting and flaking of the chromium took place, producing what appeared to be an indelible stain. Flaking occurred much less readily than on a highly porous surface, since in this case the chromium was much thicker.

Chromium deposits less than 0.000005 in. thick were highly porous and lost brightness too rapidly to be regarded as a durable finish. Current specifications required a minimum chromium thickness of 0.00001 in. except in deep or awkward recesses, and over the greater part of an article the thickness might be 0.00002 in. or thereabouts. At this thickness the chromium was still rather porous. At least 0.00003 or 0.00004 in. was required for really low porosity, and yet under conventional conditions of deposition at about 0.00004 in. chromium was apt to crack, if not immediately then on exposure to a corrosive atmosphere. In fact, in conventional chromium plating there was hardly any range of thickness over which the deposit was free from both pores and cracks.

Raising the plating temperature reduced the tendency to crack. If the current density was raised at the same time a bright appearance was retained as well. Deposits three or four times the normal thickness and with very low porosity could thus be produced without much danger of cracking. Such deposits had been shown seven or eight years ago to have marked advantages in outdoor exposure.

The advantages conferred by these thicker deposits had been demonstrated in their own recent exposure tests on plated die-castings. The results had been published, and there were some examples in the exhibition held in connection with the Conference of plated handles showing a remarkable improvement up to thicknesses between 0.00005 and 0.0001 in. The smaller castings, forming part of a later series of tests, indicated a gradual but distinct improvement as the thickness was increased in smaller steps from 0.00001 to 0.00002, 0.00003, 0.00005 and sometimes 0.00008 in. These chromium coatings had been deposited from various baths and there did not seem to be a great deal of difference between them at any particular thickness. Even conventional deposits up to 0.00003 in. were not greatly inferior as yet, but they did show considerable cracking. The results did not support a claim made by Battelle that baths of intermediate concentration, around 340 g./l., gave deposits of lowest porosity. That claim had been based largely on electrographic tests, and their own examination of this technique of detecting porosity had made them very suspicious of it. They found that it revealed many fewer points of attack than occurred in outside exposure, and yet they were convinced that it actually dissolved chromium to an appreciable extent.

Power and materials costs for chromium plating alone were, of course, about trebled, and so was the generator or rectifier capacity required. If much higher current density than normal was used the solution had to be cooled and extra precautions had to be taken to ensure adequate contacts and conductors. Alternatively, if more concentrated solutions were used, at moderate temperature and current density, longer plating times would be required and the bath must be enlarged. These things could be done, at a cost which should be very reasonable in relation to the total cost of plating. There must be an increase in total cost, but the increase should be well justified by improved performance.

At this thickness (0.00003 in. min.) there should be no difficulty with loss of brightness, but it was advisable to ensure that the work entered the chromium plating bath with a low voltage applied, the full voltage coming on after a few seconds of immersion. In some American plants the current was surged between high and low values in a regular cycle throughout the plating time. This was said to improve brightness and colouring.

On really difficult shapes some cracking might well occur in high current density areas, even with the best conditions of chromium deposition. The consequences were by nomeans disastrous. The nickel was thicker in these areas in any case and penetration to the basis metal was likely to be long delayed, but the cracks were visible and might well be considered undesirable. A good deal could be done to improve distribution by careful racking of the work, and much more by the use of insulating screens, auxiliary cathodes or robbers and auxiliary anodes.

For completeness he said a few words about micro-cracked chromium. Very finely cracked chromium could be obtained in a single layer, particularly from rather dilute solutions containing mixed catalyst acids. These solutions, however, had poor covering power on nickel and it seemed very difficult at the moment to obtain a uniform crack pattern with them in high- and low-current density areas, and so in practice micro-cracked

chromium was achieved by a dual or duplex deposit. A layer of initially crack-free chromium was followed by a layer of micro-cracked chromium. There seemed to be no doubt that the first layer cracked when the second layer did, so that the composite functioned as a single micro-cracked coating. The advantage of applying it in this way was that the coverage obtained with the crack-free chromium on nickel was quite good, while even the more dilute second bath covered chromium reasonably well.

On the other hand, he doubted that the difficulties of applying a suitable dual coating to complicated die-castings had been overcome. It was very difficult to achieve the required thickness and crack pattern in recesses. The few tests which they had so far carried out at Euston had confirmed this. Furthermore, the avoidance of visible micro-cracking could not be completely guaranteed. The Metal and Thermit Corporation, who had also worked on dual chromium and were suppliers of the process, seemed to think that for complete satisfaction 0.0001 in. min. was required, although 0.00005 in. should be reasonably adequate. Battelle's limited tests had led to a similar conclusion and in fact their present recommendation was for 0.00015 in. dual chromium.

Even at 0.00003 in. dual chromium would be rather more costly than an equal thickness of crack-free chromium, and to increase the thickness by anything up to five times would seem to be prohibitively expensive. The benefits of the process were not yet fully established, nor had all the technical difficulties been surmounted, so that it would seem to be rash at the present time to employ the process on anything but an exploratory scale. To use 0.00003in. min. crack-free chromium seemed to be a much better bet. Applied on top of a full 0.001 in. of bright nickel, or better still duplex nickel, it should give a vast improvement over the quality of plating which was at present customary.

DISCUSSION

Mr. L. A. J. Lodder (Imperial Smelting Corporation Ltd.), opened the discussion by referring to his visit in the autumn of 1959 with Dr. Edwards, to the United States. They had visited seven plating plants, attended a symposium organized in Detroit by the American Zinc Institute, and heard papers and discussions on the various plating schemes in operation in the United States and also discussions on exposure tests and records, both accelerated and outdoor.

There was a good deal of work in hand in the United States by the motor-car industry, the supply houses and the Battelle Memorial Institute. Battelle had begun a very intensive programme in 1957 and, apart from a good deal of other work, had run a series of exposure tests with the main aim of improving considerably the durability of plated zinc alloy die-castings. Since then they had run three programmes. The main point of the first programme, which had been recorded to the stage of 90 weeks of outdoor exposure at three sites (Curie Beach, Detroit and Columbus), was the finding that a crack-free chromium coating of 0.00008 in. very considerably improved the resistance of the copper-nickel-chromium scheme.

The second programme, which had reached the stage of 60 weeks outdoor exposure, had cast some doubt on the value of the duplex nickel coating of the type that Dr. Edwards had described—a duplex coating with the sulphur-free columnar semi-bright nickel as the base—unless coupled with a conventional chromium coating of at least 0.00002 in. thickness. On this programme after 60 weeks 0.000055 in. of crack-free chromium was found to have performed very well at all sites over a bright nickel coating.

The third programme of the Battelle Institute was at an early stage at the moment, but it had shown that after up to 10 weeks exposure at Curie Beach specimens with only 0.0004 in. of duplex nickel and 0.00001 in. of conventional chromium were badly blistered and were much inferior to the specimens in the second programme with a similar 0.0004 in. thickness of bright nickel but 0.000055 in. of crack-free chromium after 14 months exposure at the same site. This illustrated the effect of sub-normal nickel thickness in recesses and the potential value of thicker chromium in counteracting it.

The main results from Programme 3 at the moment had been from accelerated tests of up to 108 hours, which showed an advantage for duplex nickel and for thicker bright crack-free chromium, and an exceptional advantage for both of them in combination. The exposure tests which his own organization had undertaken at an industrial site were showing to advantage thicker bright crack-free chromium, at least to a thickness of 0.000025 in. and over. More recent tests which were in hand and which were at an earlier stage showed duplex nickel in favour compared with a similar thickness of bright nickel.

The situation with regard to duplex nickel in the United States was somewhat confused by the fact that duplex nickel had come in at a time when very considerable attention was being paid to the control of thickness of nickel deposits. The specification thickness of nickel had been stepped up to 0.0012 in. at about the same time. Evidence from Battelle suggested that the best results would be obtained only if duplex nickel was used in conjunction with thicker crack-free chromium, in which case the combined effect might exceed

the sum of the individual benefits, so that a very considerable uplift in durability could result.

In the mean time, thicker crack-free chromium, which had been selected as holding a good immediate prospect for improvement, had been examined, and that promise seemed to have been fulfilled in the eyes of both Battelle and the BNFMRA. A good deal had been published and was known with certainty about the outdoor durability of thicker crack-free chromium, and there could be few doubts about the benefits which it provided, although there might be some doubts about the technique of deposition. Dr. Edwards had already mentioned the use made in the United States of robbers, shields and auxiliary anodes, and their use to secure better distribution of chromium was very interesting.

MR. H. C. CASTELL (Mond Nickel Co. Ltd.), said that the Conference had been given a brief outline of the impact of the new processes in America, but the position might be a little different in the United Kingdom. There appeared to be no doubt that thick chromium deposits could improve the corrosion resistance of nickel and chromium plating when this was exposed in very severe service applications, as on motor cars. The work which the BNFMRA had done, coupled with that carried out by the Battelle Memorial Institute, left little doubt that even moderate increases in the thickness of the chromium layer, when deposited in a crack-free condition, could show substantial improvements in the resistance of a bright nickel and chromium plated part.

A difficulty which might arise with thick chromium deposits concerned uniform chromium distribution over the surface of complex shapes. It was true that the BNFMRA had shown in Development Report No. 62 that the distribution of chromium which was plated nominally to five or eight times the conventional thickness was fairly satisfactory and in fact showed ratios of 3/1 to 5/1 between the thickest and thinnest regions when plated on to production die-castings. He wondered, however, whether or not the same distribution would be obtained if these components were plated by the thousand in a production shop. On the BNFMRA results it would appear that the throwing power of chromium, plated under crack-free conditions, was not much worse than that of nickel.

It was known that a negative throwing power meant that, in addition to the primary current density effect, in which peaks received more metal than valleys, the solution itself aggravated this situation by increasing the thickness on peaks. The more negative the throwing power, the greater the disparity between the thickness on peaks and that in the valleys.

If no greater protection in terms of increased chromium thickness could be given to recesses of low current density, even though much greater thicknesses were plated on to peaks, there might still remain the problem of corrosion breakdown in recesses which existed with conventional thicknesses of chromium. This emphasized the need for satisfactory thick undercoats of nickel, consideration of the shape of the article from the design and practical plating points of view, and rigid adherence to specification requirements for the thickness of the nickel layer.

Turning to developments in the nickel plating field, although the BNFMRA had not yet had an opportunity to make a thorough evaluation of duplex nickel it was clear from work carried out in the United States that this system, when operated from properly balanced and constituted solutions, gave enhanced protection to the basis metal. Apart from the enhanced corrosion protection which it afforded, the installation of a duplex nickel plating system did not involve any major alterations to existing plant. It was true that in automatic plant the nickel plating tank would have to be divided into two cells and some modification might be necessary to the timing and operation of the transfer equipment, but in manual plant where two or more vats had existed previously no changes were required. Further, no additional rectifiers and no modifications of racks to take extra current which might be needed for plating chromium under crack-free conditions were required.

At the present time he would recommend, to give the best protection to zinc and steel parts, a duplex nickel undercoat followed by a chromium top-coat applied under the conditions recommended by the BNFMRA from a high-ratio, high-temperature solution to give a thickness of the order of 0.00002 to 0.00003 in.

In his opinion, a very large proportion of the cases where premature breakdown by corrosion of the basis metal had taken place had been due to insufficient thickness of the nickel deposit. Very often it had been found that metal distribution allowing thin deposits in recessed areas caused failure in these regions. This situation called for recommendations to manufacturers and platers on four specific points.

1. In designing a part, a plater should be consulted at an early stage so that deep recesses and sharp corners, leading to poor distribution of both nickel and chromium, could be avoided.

2. When buying plated parts the manufacturer should rigorously enforce a specification, particularly in terms of deposit thickneses.

3. The plater should ensure that electrical contacts between rack and cathode bar, and the work and the rack, should be sound in all cases. Greater attention should be paid to the arrangement of

the work on the rack so that all the articles being plated received their proper share of current and deposit.

4. Greater control of thickness was necessary by more frequent measurement, using some form of non-destructive test.

MR. H. L. QUICK (Humber Ltd.) remarked that a good deal of what had been said related to the future and to what might happen in perhaps six months' time. It might be of interest to come back to the position which existed at the present moment and view it as it affected the motor industry, who were probably the biggest users. Too many of the failures were due to process defects. This to some extent was associated with the die-casting and to a large extent with the plating of the casting.

This indicated, that before putting in processes to obtain thicker chromium and duplex nickel, attention should be paid to the inspection and control of the existing process, rather than to the installation of a technique which might prove even more difficult to control. He hoped that the die-casters would review the situation and see what they could do ; he felt sure that there was room for a great deal of improvement there, although Dr. Edwards had suggested that the presence of defects in the die-casting surface made no significant contribution to the deterioration of the plated article.

Design had been criticised. The motor manufacturer's first consideration was to sell his vehicles. In the matter of design, however, platers and die-casters could do something to help themselves. They tended to accept the drawings given to them and not contest anything. He had taken part in a number of discussions where the plater had put a price on a part which had surprised him, because he would have expected the plater to contest the design from the start. If the plating industry and the die-casters got together and pressed this point strongly they could bring pressure on the designers to improve their designs from this point of view.

What was the outlook ? There might perhaps be a 50 per cent improvement in durability, but there would still be the loss of gloss, the loss of chromium colour, and blisters. They would merely be exchanging one type of defect for another, which was not a bright prospect. Time was also a factor which was going against them ; they were probably at least twelve months away from getting most of the things which had been proposed so far. He asked platers and die-casters to see, therefore, what they could do to improve their quality, inspection and control of their processes, since so many of the faults were process defects.

MR. D. N. WALKER (Wilmot Breeden Ltd.), expressed surprise that Dr. Edwards had not mentioned direct nickel on zinc and had dealt only with copper-nickel. Dr. Edwards also mentioned that some effect had been found from storage. Mr. Walker's firm had done long-term tests on storage. Castings had been stored for two years in a variety of conditions and no effect whatever had been found.

There was one point which seemed to be missed completely by designers, platers and those who wrote the instruction books for motor cars. His firm regularly examined cars in Birmingham and found invariably that the order of merit in cars two or more years old was the driver's door handle, the passenger's front door handle, the handle of the near side rear door, and the handle of the off-side rear door. That indicated that some sort of cleaning action was performed when the door of a car was opened. There might with advantage, therefore, be something in the instruction books about cleaning these parts.

MR. H. J. BACHE (Electro-Chemical Engineering Co. Ltd.), commenting on Dr. Edwards' statement with regard to copper plating, said that the BNFMRA had carried out tests using various thicknesses of copper and had found that there was practically no difference in the corrosion resistance or corrosion effects on the basic casting, and asked what had been the minimum thickness used and whether or not any fresh information had come to light which would suggest that there should be less than the 0.0002 to 0.0003 in. customarily used.

Turning to nickel and referring first to multiple nickel coatings, it occurred to him that such deposits as duplex nickel and bi-nickel had gained a reputation for themselves largely on the basis of accelerated corrosion tests, which they could pass successfully. It might be that at the moment they were in a state of transition and that the multiple nickel and dual nickel coatings would help them in the future to produce a much better corrosion-resistant system than currently existed. He believed that duplex nickel would help them at this juncture, but it did not appear to be the complete answer. It was true that atmospheric exposure had shown multiple nickel to be roughly the same from the point of view of corrosion as bright nickel followed by chromium.

Several speakers had mentioned the benefits to be obtained by using thicker or thick chromium. Undoubtedly this was true, but there was one danger which must be borne in mind. When the warmer chromium solution was used at a higher current density and a larger ratio a thick so-called crack-free deposit was obtained, but there were cracks and flaws in these deposits, though to a much smaller extent than in a conventional chromium deposit. The important factor here was the relative area between the cathode, which was chromium, and the anode, which was the nickel

at the bottom of the pores and the cracks. Where the ratio of cathode area to anode area was very high, the rate of penetration of the chromium coating would be rapid, and in a short time it might be found that the article was very badly disfigured. Where the basis metal, for example, was steel, and nickel at high temperature and high ratio or crack-free chromium was applied in those circumstances, the failure could be quite severe. Whether the basis metal was covered with copper, as in the case of zinc-base die-castings, or steel or brass, the failure was delayed, but when it did occur it was normally rapid.

Finally, there had been no specific reference to what were called sandwich coatings. All the tests which had been carried out to date accelerated corrosion tests and atmospheric corrosion tests, had shown that sandwich coatings of Ni-Cr-Ni-Cr gave extremely good corrosion results under both accelerated and atmospheric corrosion conditions. As with duplex chromium, it was too early to judge how valuable the sandwich processes would be, but in the long run it might be found that to obtain the very best corrosion resistance a sandwich process should be used which contained duplex nickel in between two layers of chromium.

DR. EDWARDS, in reply, said the range of thickness of the copper undercoat to which he had referred was only the range on commercially plated articles where the aim was the specification minimum of 0.0003 in., so that the variation had been between 0.0001 and 0.0005 in. They had found very little effect from the variation of the copper between those limits. On the other hand, below 0.0001 in. there was a danger that the copper would not be continuous over the whole article and therefore a process defect would result. Satisfactory results had, however, been reported with 0.00005 in.

In reply to Dr. Walker, it would be a mistake to say that an improvement in plating generally would necessarily result in a reduction of the very low return of 0.2 per cent. Presumably there would always be a certain proportion of defective work which got through and the only way to reduce that was to improve inspection.

On the question of cleaning plated surfaces to lengthen their life, he knew of no direct evidence that cleaning the surface improved performance, and in their tests they had not found this to be so. He did not deny that the driver's handle was often the best one on the car, but there could be some other explanation.

MR. U. MARX (Wilmot Breeden Ltd.) wished to emphasize one element which had been touched on already and which had been mentioned in connexion with inspection standards.

If reliance could be placed on process control the question of inspection at the end would not arise, because it would be known that everything produced was satisfactory. He suspected that there too many variables in the process of die-casting that tended to give variable quality in what came out of one machine from one hour to the next. It was certainly so in plating.

One of the most important tasks of any plater, and, by extrapolation, of any diecaster, was to ensure by process control, on the same lines as in the heavy chemical industry, that the quality of the product was constant and remained constant throughout the day and the week. When that stage was reached the failure rate once the article had gone out would begin to come down ; but so far as motor cars were concerned, if in petrol there were variations of the kind found in plated components or die-castings, and after filling up at one plant the driver got 35 m.p.g. and after filling at another only 25, he would not be very pleased. That difficulty had been overcome because the oil companies kept a very tight control on their product all the time. That must be done with plated components to a much greater extent than at present, and that point should be re-emphasized.

In conclusion, MR. G. D. BURTON (BNFMRA) said that following the paper and discussion on the question of using thicker chrome it might be apposite to mention that one of the main problems of the BNFMRA was to measure the chrome. To date they had two methods which had been accepted : (i) stripping and weighing, which, though it gave very good results if carried out correctly, was tedious, and (ii) the gassing test, which had so many variables that the best ratio which anyone claimed was about $\pm$ 15 per cent.

The Association, therefore, had decided to carry out some research on a coulometric method of measuring chromium plating thickness. This provided an accurate method of determining the chrome thickness.

The main work involved had been first to find a solution or solutions for the various plating deposits and also the basis metals to give the characteristic rise in voltage on getting on to the basis metal. To date they had covered solutions for chrome, nickel, copper, zinc and various other metals and also the various basis metals, and they were fairly confident that they could get very good results. The accuracy which they obtained at the moment was $\pm$ 2 per cent.

The other problem had been to design a cap to give them a defined area. They had tried various plastics and eventually chose p.v.c., which was fairly stable and, provided they changed the cap once a month, would give them a clearly defined area. They had entered into a contract for the

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"DIRECT-ON-WHITE" ENAMELS MAJOR TOPIC AT "FERRO" COURSE

THE 16th in the annual series of refresher courses in the art and science of vitreous enamelling organized by Ferro Enamels Ltd. was held this year from May 25-26 at the company's Wombourn Works, and attracted its usual attendance of some 60 enamelling technicians from all over the country. Lectures and discussions ranged over a variety of enamelling subjects, including the corrosion-resistance of enamels, low-pressure spraying, enamelling furnaces and equipment, and the preparation of enamelled specimens for microscopic examination.

One session at the Course was devoted to the subject of "one-coat white enamels" and two lectures were delivered, one covering the subject of metal preparation, and the other discussing the enamels themselves. A brief summary of some of the points referred to in these two lectures appears below.

Metal Preparation and the Ferro Direct-on-White Process

Much of this lecture, which was given by Mr. A. H. Symonds, discusses the relative merits of various acid pickling processes in relation to the one-coat finish. The desired criteria for an adequate pickling operation are effective removal of all oxides, production of a moderately etched surface for improved adherence of enamel, and ease of rinsing of residual iron salts. The recommended pickling medium is phosphoric acid which, in addition to exhibiting the desired qualities, is also susceptible to control in relation to its iron content by ion exchange.

A further essential step in the preparation of steel for one-coat enamelling is the nickel dip whereby a deposit of some 0.1 gm. per sq. ft. of nickel is deposited on the ware by direct displacement. An improvement on this process makes use of a solution incorporating a reducing agent whereby a more controlled deposition of an adequate nickel coating is possible.

The type of steel sheet used for the manufacture of ware to be enamelled has a considerable influence on its enamellability, and in this connexion a very low carbon content is the most desirable property. Enamelling-quality steel as obtainable in the U.K. normally contains 0.05 to 0.07 per cent carbon, but being rimming steel the carbon content of the surface layers is normally significantly lower. An interesting development, which may have considerable significance in relation to the production of steel of enamelling quality, is the production of steel sheet in which the carbon content has been reduced to as low as 0.01 per cent by appropriate heat treatment in a decarburizing atmosphere.

The cycle of operations for pretreatment for the direct-on white process is recommended as follows:

1. Hot alkaline cleaner.
2. Hot-water rinse.
3. Cold-water rinse.
4. Heat treat at 650°C. (at temperature for 2 minutes).
5. Pickle in 17 per cent phosphoric acid at 50-55°C.
6. Acid rinse at *p*H 2.5 (adjusted with H_2SO_4).
7. Nickel dip.
8. Hot-water rinse.
9. Dry if necessary.

The lecture concludes with some figures of comparative costs between conventional two-coat enamelling as compared with direct-on white on refrigerator liners based on experience in the United States. This shows a cost of 3.1 pence for the direct-on coating as against 4.3 pence for the conventional coating.

Enamels for the Ferro Direct-on Process

It is pointed out at the beginning of this lecture by Mr. A. T. Issitt, that it has been possible for some years to apply a one-coat white enamel to a titanium-bearing steel and the purpose of recent developments has been to evolve a white enamel capable of being applied direct to a non-premium steel sheet. The traditional ground-coat enamel containing cobalt, nickel and manganese, because of their interaction with the oxide coating on the metal base during the firing of the coating gave very good adhesion, and one of the problems in developing a one-coat process has been to obtain adequate adhesion in the absence of the dark-coloured cobalt-bearing ground coat. This problem has been largely met by the introduction of the nickel-dip procedure.

The desired characteristics of a one-coat enamel are summarized as follows :

1. It must be capable of combining readily with the pre-treated metal surface without the formation of pin-holes and black specks.
2. It must be sufficiently fluid during firing to produce a good finish.
3. It must not be so fluid as to cause sagging on vertical planes during firing.
4. It must have a suitable coefficient of expansion.
5. It should have a firing temperature sufficiently low to reduce the tendency of the ware to distort during firing.

Basically the application of enamel using the direct-on process follows very closely conventional enamelling techniques although some aspects of

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Applications of Zinc Coatings

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Ventilation Equipment

Equipment for pumping fresh air in and fumes out forms another large field of application for zinc coatings. Ships' ventilators have already been mentioned, but zinc coatings are also used to protect the fan casings, impellors and ducting to which the air intake is connected — not only on ships, but also in mines, factories, homes and public buildings. The interiors of ducts need special protection as they are not easily accessible for maintenance and usually act as surfaces on which drops of liquid tend to condense. A good example of the application of zinc coatings in this field is to be found in the Festival Hall, London, where over 150 tons of ducting has been constructed from hot-dip galvanized steel sheet[11].

Air-humidifying-plants, such as are attached to germinating drums in breweries, are among typical applications of zinc coatings for protecting ventilating and similar equipment in factories.

Water-supply Equipment

Pipelines carrying industrial and domestic water supplies are in continual use, so it is essential that any risk of failure should be eliminated. Many thousands of miles of zinc-coated piping are in use throughout the world and one of the most spectacular installations is the 240-mile long pipeline which carries water from the Murray river at Morgan to Whyalla, an industrial centre in South Australia ; this has been protected with a 1-oz. coating of a paint consisting of zinc dust dispersed in an inorganic silicate cement—no deterioration was visible after the first 16 years of service.

Elsewhere, zinc-coated storage tanks and filter troughs are giving equally good service in townships throughout the world. Indoors, hot-dip galvanized tanks, cylinders and pipes are, of course, standard equipment ; they have been mentioned already in the section on " Domestic and Institutional Equipment."

Miscellaneous

To show that the above sections do not by any means exhaust the wide range of iron and steel articles which are zinc coated to protect them against the ravages of corrosion, a few unusual ones are now listed : the clock hands on Shell-Mex House, London ; a monkey cage for a medical research laboratory ; fish hatching tanks in America ; a wind tunnel near the sea coast ; shoe lasts ; the steel drum in which the Irish Sweepstake entries are shuffled ; bread racks in bakeries ; sterilizers in dairies ; petrol pump fittings ; Belisha beacon standards (which are invariably sherardized ; electric kettle safety devices); and lamp posts.

But the list is still far from complete ; there are, in addition, such common-or-garden items as chains, hooks, eyelets, and valve springs (where zinc coating also helps to prevent corrosion fatigue, the weakening which occurs in a metal after it has been repeatedly stressed in the presence of corrosive agents).

Truly, zinc is a versatile coating metal.

(*Series to be concluded*)

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" Direct-on-white Enamels "

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the process call for special attention to control measures, for example as follows :

1. Pickling must be carried out in conformity with the specification laid down.
2. All ware must be very carefully handled and kept free from contamination.
3. The enamel selected must be suitable for the particular application.
4. Milling procedure should be in accordance with specification.
5. Application should be controlled to give a suitable thickness and surface finish.
6. Care must be taken to avoid damage to the coating at the bisque stage.
7. Accurate control of firing temperatures and cycles must be maintained.

Better Plating on Die-Castings

(*Continued from page* 361)

manufacture of this. The price would be approximately £125 and delivery at the moment about two months.

The other instrument was the thermo-electric plating gauge. Site trials had been carried out with this instrument on nickel on steel, nickel and copper on steel and nickel and copper on zinc. For nickel on steel they had taken 850 readings by four different operators, to eliminate operator trouble, and had a standard deviation of 0.000047 in. For nickel and copper on steel, which was the most difficult, they had taken 222 readings on 174 items and the standard deviation was 0.000073 in. On zinc die-castings they were better off ; they had taken 159 readings and had a standard deviation of 0.00005 in.

A Quarterly Survey of some of the Feature in Finishing Literature from Abroad

by **SCRUTATOR**

INCREASING use of anodized trim on automobiles has focused attention on the sealing operation. This is a vital stage in the anodizing sequence as it improves corrosion and steam resistance and, with coloured work, wash and light-fastness of the dyed film are also greatly increased. On decorative work, the most normal sealing procedure is immersion in boiling water but as this produces no readily visible effects, there is a need for a test to ensure that consistent, high-quality sealed work is being produced. In addition to discriminating between well and inadequately sealed surfaces, such a test should also be cheap, reproducible and easy to carry out. Work by Cook and Spooner[1] on the Kape test has shown that it meets all these requirements.

Testing consists of immersing the anodized and sealed surfaces in a warm acidified sodium sulphite solution for a few minutes. The resultant bloom provides a direct measure of the degree of sealing. Thus by preparing a set of standards showing different degrees of bloom, the efficiency of sealing can be determined on production. The sealing of anodic coatings is also critically reviewed by Cohn and Sossan[2], with particular reference to recently published information supplemented by experimental work of their own.

Pearlstein[3], has carried out some interesting experiments on the effects of sealing when anodized aluminium is exposed to corrosive conditions in contact with a metallic copper surface. Hot dilute sodium dichromate solution is frequently used for sealing for non-decorative purposes where maximum corrosion resistance is important, and surfaces so treated will stand more than 240 hours in the salt spray. When placed in contact with a more noble metal, such as copper, however, under similar conditions corrosion generally occurs in 48 hours or so. To obtain greater protection against dissimilar metal corrosion, tests were carried out using a double sealing technique. In these, hot 5 per cent sodium dichromate was used as a ' pre ' or ' post ' seal and a variety of different materials as the other seal. Each sealing operation was for 10 minutes immersion at the boil followed by rinsing. The greatest improvement in the resistance of anodized aluminium in contact with copper, under salt-spray conditions, was obtained by pre-sealing in alkyd aryl polyethylene glycol or nickel acetate and post-sealing in sodium dichromate.

Ultrasonics

The use of ultrasonics in metal-finishing processes is not new. Most of the available published literature has, however, contained considerably more sales than technical information, which makes all the more interesting the recent paper on ultrasonic agitation in pickling and cleaning baths by Osterman and Santa Lucia[4]. To demonstrate the potentialities of ultrasonic cleaning and pickling, a working model of a bar pickler was constructed using 1 ft. diameter cog wheels and capable of pickling bars up to 1¼ in. diameter and 1 ft long. Experiments were conducted using single specimens in contrast to production practice where bundles of bars or tubes are treated. Using 10 per cent sulphuric acid it took 18 minutes and just under 2 minutes to descale completely 1010 steel without and with ultrasonic agitation respectively. They also found that ultrasonic agitation enabled a higher concentration of iron salts to be tolerated.

Quantitative results with regard to the effects on metal cleaning are more difficult to obtain but they claim that if cleanliness is rated over a scale of 0 to 1000,1000 being completely clean; results obtained using ultrasonic agitation were generally in the range 900 to 1000 whereas without it they fell within the range 450 to 500. It is also interesting to learn that an ultrasonic cleaning line just under 10 ft. in length is in production use for the removal of buffing compounds from high quality wire travelling at 1,000 ft. per minute.

Rubenstein[5] has also described the ultrasonic cleaning of bent stainless-steel tube assemblies for fuel and hydraulic systems in supersonic aircraft. Absolute cleanliness with particular reference to the complete absence of small metal particles produced when cutting the tubes is essential and it is claimed that this can only be obtained by the aid of ultrasonics.

Painting

In the field of organic coatings, Kurk[6] has described a new flow coater called the ' Oscicator.'

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MODERN APPLICATIONS IN CHROMATE COATINGS

By KENNETH P. BELLINGER*

TO describe briefly what is new in chromate coatings, it is necessary to review how chromate finishes started. Looking at the development in retrospect it is interesting to note the many workers in the field who have offered contributions to different phases of the chromating, and to different metals treated.

It is generally recognized that original chromating started with the work of Anderson, of the New Jersey Zinc Company. It was called the CRONAK process. This work was published as a patent about 1937, and was of almost immediate importance because of the war effort, and its attendant shortage of metals, such as nickel. Briefly, it was found that the presence of hexavalent chrome in an aqueous solution to the extent of 1/10,000 gm. per litre would offer protection to zinc. Through the use of chromate and sulphate anions a zinc bichromate film could be applied to zinc or cadmium, which film carried water of crystallization, and undoubtedly some trivalent chrome. When dried on the work the film was very slightly soluble and had the tendency to leach in the presence of moisture. As long as there was film for leaching, corrosion protection was offered to the base metal. It is probably safe to say that practically all developments in this field since that time have been based on improvements of this original idea. Whereas the original film was a yellow to brown colour, films available to-day range from clear bright to dark olive drab ; and whereas the original purpose was only corrosion protection, it is probable that the bright attractive appearance offered by some of these films to-day is as important as the corrosion protection.

During World War II the corrosion protection feature was used to a great extent on both zinc and cadmium and shortly thereafter, bright treatments, which involved rather heavy chemical polishing of the treated metal, with a subsequent alkali leach were announced. The earliest attempts at bright treatment involved rather concentrated baths with an attendant rapid metal removal, and high drag-out loss. There was some feeling in the trade that they would have a rather temporary application until nickel would have become plentiful.

Revision of this earliest solution followed rather rapidly and a considerable amount of bright zinc work was treated in baths that averaged about 15 to 20 per cent in concentration at dwell times of 15 to 20 seconds, this treatment being followed by an alkaline leach prior to rinsing and drying. The continued shortage of nickel caused by the Korean conflict produced a steady pressure for bright finishes, with an attendant growth in bright chromated zinc requirements. During this period it became quite obvious that certain applications were best suited to this type of finish, and that they would not return to nickel at almost any price, or degree of plenty. Examples of this were ice-skates and drapery hardware and automobile hardware of a semi-concealed nature. There were some disadvantages to this type of operation. The treatment was relatively expensive because the life of the baths was not indefinite. Delayed action set-downs were required on some automatic processing. Disposal of the spent solutions and of the rinsing waters began to be a problem, and sometimes the leaching caused staining on bulk treatment. Instances are known of where mild acids were substituted for the alkali in the leach operations, and were so effective as to remove virtually all the protection.

As a result of this there was widespread acceptance of the dilute one-dip treatment, when they were announced to the trade. These solutions are composed of a powder, offered by the manufacturer of the process, to which is added some nitric acid by the customer for make-up of the solution. The total concentration of this solution is about 2 per cent by weight. The cost of the chemicals used has dropped to about 10 per cent of former requirements. Whereas these treatments are not considered quite as "deep polishing" as former treatments, and whereas the additional

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corrosion protection might not be of the same order, there are many advantages that are overwhelmingly in their favour.

Apart from the cost, the colour remains more uniform, with less chance for iridescence throughout the life of the bath. Dwell times can be varied through a wider range. The baths do not have to be heated, and in fact favour a cooler temperature of *e.g.* 60 to 75°F. Rinsing is very easy ; there is no leach, and as a result there is none of the staining on bulk treatment associated with the previous processes. Carboys, with their attendant deposits and high commodity rates for handling are eliminated.

Up to the moment the discussion has been primarily concerned with bright treatments on zinc, as this was by far the biggest consumption of any application. It has already been mentioned that the heavy films of the iridescent and olive-drab type had an early acceptance during the war effort and this continued through the Korean conflict.

Early filming treatments were soft and gelatinous as formed when wet, and could not be easily processed without bruising. If the parts were treated too long the finish would build up to a heavy film and slough off. In the last five years modifications of this type of treatment have produced both iridescent and olive drab films from stable baths, which are much harder when wet, and do not mark on normal bulk handling. This is of special interest to those operators wishing to dye the films for producing either black or other colours for coding or identification work. It is normal to anticipate no marks on the work after dyeing with this type of bath. Obviously a part such as a flat washer would have to be handled so that the treating solutions would reach all of the film surface.

In the United States coloured chromate films of either iridescent or olive drab types must undergo 96 hours in salt spray with no white corrosion product to be acceptable for government contract application.

It has been mentioned earlier that it was a characteristic of the chromate film which was hydrated to leach and offer corrosion protection. If parts are dried for too long at a temperature greatly exceeding 212°F the water of crystallization can be driven from the film, it becomes insoluble and much harder, losing its corrosion protection. This phenomenon must be taken into consideration where chromated surfaces are to be painted, and baked at high temperatures.

It was discovered in the early developments that the clearer films did not particularly interfere with the soldering and one of the very early applications in the States was the treating of radio chassis. It was soon learned that there was another advantage to the chromate films in that they did not offer a high resistance to the passage of electric current. As a result, assembly of radio chassis turned to spot-welding rather than soldering, with the subsequent elimination of flux, and its tendency to stain around the point of application.

Of particular interest is the low current resistance because the other two chemical conversion coatings, *i.e.* phosphates and oxides are to a varying degree good dielectrics, and use is made of this characteristic in measuring film thicknesses.

Whereas the earliest bright treatment on zinc was in a concentrated solution, one of the early treatments for cadmium was a comparatively dilute bath, which probably never found greater acceptance because of its tendency to yellow the cadmium, particularly if not operated in close limits. Early deep polishing treatments on cadmium were not widespread as they operated in the 30 per cent range, giving a rapid metal removal, and requiring concentrated leaching, with the final film being bright, but with a tendency for iridescence. Possibly because of the higher expense involved in cadmium versus zinc a general acceptance of chromating of cadmium surfaces did not take place as soon as did the chromating of zinc.

To-day solutions of the order of 3 per cent may be made with a single powder and water which is self-balancing, and requires only additions of the same powder to operate for periods of weeks to months. Control is normally by appearance of the work. No leaching is required, and the resultant finish is a clear silvery-white with good corrosion protection. It is normal for this type of finish to be rated, not by salt spray, but by 5 per cent lead acetate test, in which work that has been dried for approximately ½ hour is tested with a drop of solution. Protection in order of 20 to 30 seconds prior to the drop turning black is considered adequate.

Whereas the previously mentioned dilute dip for zinc allows bulk treatment even in a horizontal plating barrel, in relatively ideal conditions, this is not true for cadmium — because the hexavalent chromate contamination of the first rinse must be kept low. Application in automatic perforated oblique type bulk plating equipment is practical. Here the first rinse station is operated empty, and water is introduced into the open end of the barrel in considerable volume to give a quicker clean rinse at this station. This type of chromate treatment does not interfere with subsequent soldering, which again is an everyday occurrence.

It would be well to mention at this point that cadmium baths operated with too high a co-depositing metal content for brightness can cause these difficulties ; on clear chromating—a " cloudy bluish haze " will form, on olive drab treating—the surface will become blotchy, on soldering—poor

adhesion will result. Other difficulties can be a reduction in ductility, and a reduction in corrosion protection as measured by the acetic-acid-type salt spray.

Here again, as with zinc, the clear chromates on cadmium allow for a wide variation of dwell time, concentration, and no leach is necessary. For automatic operation, the treated tank should be agitated, in fact in all of the dilute chromating applications agitation gives superior results.

In chromating of copper and brass, baths are offered in concentrations varying from 3 to 30 per cent which operate from room temperature to 140°F. A characteristic of all the baths is that they do not fume, they offer a uniform colour with no subsequent staining, and in many cases corrosion protection that will eliminate lacquering. Brightness is associated with the higher concentrates and the higher temperatures. The requirements in this field are numerous, from the pickling of a brass casting with black scale, through the soldering applications to the production of bright work, with its attendent elimination of mechanical finishing. No one composition meets all these requirements, but products are offered, using either powders and water or powders and water with the addition of nitric acid, that can handle many of these applications very economically.

There is considerable use of dilute solutions, chromate bearing, which are used for cyanide neutralization after brass and copper plating, and they have been most successful in the prevention of spotting out, at the same time giving better subsequent lacquer flow or coverage.

In the field of zinc die castings a powder is now available to the customer, which when mixed with water and nitric acid not only effectively bright dips for subsequent plating operations, but at the same time gives effective flash or burr removal. This is of importance on parts which, due to their shape, may not lend themselves to either barrel or wheel finishing. An example would be fuel pumps and carburettors. If the subsequent chromate film is not removed for plating purposes it serves as corrosion protection for the article in commerce. The same powders are used for producing iridescent and olive drab finishes on zinc die-castings, which are used for either zinc or cadmium, with the same attendant economy, uniformity of finish and hard wet film strength.

It is normal to alkali-treat the die-castings prior to chromate treating to get uniformity of application.

Various customers who have investigated the chromate treatment on zinc die-castings find that bright iridescent coatings often offer as good, or better, corrosion protection than would the heavier iridescent or olive drab films, and this holds true on lacquering. Obviously this is as opposed to the heavier films, offering the better corrosion protection on zinc and cadmium.

The author is not aware of a bright dip solution for use on aluminium which also offers good corrosion protection. The chromates do have a firm place in the protection of aluminium, and find the widest application as a base for paint. Films are soft, as compared to existing oxide treatment, and this can be an advantage where flexure of the surface is a characteristic of the resultant finish, as an oxide film might crack. Conversely, where hardness is a factor, the application of chromates would not be indicated. Very low treating cost has given them a wide acceptance, which we believe will tend to materially increase. A 168-hour salt-spray test, on an alloy with a relatively high copper content, is a requirement for government acceptance in the United States. This alloy is chosen so that failure will take place considerably sooner than if the copper were not present, in which case the test would be extended far too long to be practical.

The dyeing of chromate films has been widely investigated in the U.S., with a commercial sales application limited primarily to zinc or zinc die-castings. Refrigerator shelves are an example of a zinc plating item which is dyed, and subsequently lacquered. The lacquer must be of high quality, not only from the corrosion protection angle, but also for wear resistance. Wire goods and novelties, particularly items with curved or patterned surfaces are considered good applications. Application for dyeing of chromated die-castings would be furniture hardware. Chromate finishes have certain advantages to offer, such as good corrosion protection, plus good lacquer adhesion, as compared with brass plate or oxidized copper finishes. Whereas it is possible to dye almost all chromate finishes with the exception of the clear coatings on cadmium, almost all of the other dyed finishes would be for coding or identification purposes, and this is important to many companies, particularly on assembly work.

The continuous cost reduction resulting from improvements in chromate treatment have obviously broadened the base of application for the treatments. It is anticipated that the acceptance by industry and the demand by the public for a constantly improved appearance will continue the steady increase of usage for finishes of this type.

Exclusive licencees and distributors for Great Britain and the Commonwealth for the processes marketed by Conversion Chemical Corporation are Silvercrown Ltd., 178, Goswell Road, London, E.C.1.

DECORATIVE DYEING OF ALUMINIUM AND ITS ALLOYS

A Review of Some "Do-it-Yourself" Methods Advocated in the U.S.S.R.

By A. J. STEIGER

THE dyeing of anodized aluminium to make decorative metal fittings for radio receivers and TV sets is being promoted among amateur set builders in the USSR on a "do-it-yourself" basis, according to a recent Russian technical report on the finishing of aluminium and alloyed products.

The "how-to" instructions for dyeing aluminium in black, white, golden-yellow, red, sky blue, violet, green and other colours, given in the Russian report, are addressed to radio amateurs in Russia who make wide use of aluminium in building set mounting frames and screens, and are advised that the metal can also be used for decorative finish.

The do-it-yourself instructions cover the electropolishing and degreasing of the metal, the electrolytes used in anodizing and the aniline dyes used in colouring the aluminium. They are published in the Russian-language *Radio*, the author being L. Fedorenko.

Dyeing of Anodized Aluminium in Russia

The report says that for decorative finish, aluminium and its alloys are anodized with subsequent adsorptive dyeing.

Metal parts polished to mirror brilliance are degreased in a solution for 50 gm. trisodium phosphate, 10 gm. caustic soda and 30 gm. water glass. These chemicals are dissolved one after another in an iron saucepan or kettle ; then into the solution heated to 50 to 60°C. (122 to 140°F.) the parts to be dyed are put for 1 to 2 minutes.

If the indicated chemicals are unavailable, the degreasing can be done with ordinary laundry soap and warm water. In this case, the parts should be vigorously rubbed with a bristle brush for about 10 minutes.

The degreased parts are washed with cold water, and then submerged in a 50 per cent solution of nitric acid for 2 to 3 minutes after which they are again washed with an intense jet of water and immediately placed in the bath for anodizing.

A sulphuric acid solution with specific weight of 1.12 to 1.13 (15 to 17° Baumé) at 20°C. (68°F.) temperature serves as the electrolyte for the anodizing bath. As the solution is intensely heated up during the mixing of acid with water, the acid should be poured into the water in small portions while the solution is stirred constantly with a glass rod.

In case the acid splashes onto the skin or clothing, it should be washed off at once with a forceful jet of water and rinsed with a strong solution of soda.

More convenient and safer is an electrolyte made of sodium bisulphate ($NaHSO_4$), 250 to 300 gm. dissolved in a litre of water. The operating temperature of the electrolyte must also be not more than 20°C. Enamel pots or pans, ceramic, glass or plastic containers can be used as the working tank.

Sheet lead is used for the cathodes in anodizing, and the part being processed serves as the anode. It should be placed at a distance of 70 to 80 mm. between two lead cathodes.

The electrolysis is effected during 40 to 50 minutes by direct current at the rate of 1 to 1.5 amperes per square decimeter of the part surface being processed. A storage battery of adequate capacity or a rectifier (copper-oxide or selenium) can serve as the current source.

It should not be forgotten that only parts from aluminium or its alloys are subjected to anodizing. The racks for the parts must also be only of aluminium. All connexions and contacts should be made wholly reliable, because on this depends the anodizing quality. The parts should be charged in the bath and discharged only under current.

After remaining in the bath 40 to 50 minutes, the parts are discharged, carefully washed with cold water and submerged in an aqueous solution of aniline dye heated to 50 to 60°C.

The dye solution should be filtered, because small undissolved granules of dye form spots on the surface of the coloured metal. The colouration tint depends on the length of time that the anodized part remains in the dye. The dyeing takes not more than 15 to 20 minutes.

The aniline dyes being used in USSR to colour the anodized aluminium parts are, according to author Fedorenko, " ordinary powders for dyeing

(*Continued in page* 369)

Decorative Dyeing of Aluminium and its Alloys, Russian Methods

(*Continued from page* 368)

fabrics," and can be purchased in any store selling household appliances. Accordingly, he writes, the dye names listed in the article are those by which the dyes are known in the Russian retail trade. His list of 14 organic dyes covers the following base colours : black, brown, golden-yellow, red, dark blue, sky blue, green and violet, all of them in two shades except the brown and violet.

These dyes are used in a 5 to 10 per cent aqueous solution for varicoloured dyeing of the aluminium parts; parts dyed in imitation gold colour were said to be distinguishable from genuine gold only by the weight of the dyed metal. The colours of the dyed metal are fast and lightproof, he said.

The process of dyeing used to make aluminium look like gold was then described as follows : the solution is made of 1 gm. of orange dye dissolved in 0.5 l. of hot water ; to the solution are added 0.1 gm. of yellow dye and 0.5 gm. of soda ash. After cooling the solution is filtered. Separately 0.1 gm. of black dye is dissolved in 0.5 l. of hot water. This solution is also filtered. Before dyeing both solutions are mixed and heated to 50 to 60°C. A colour imitating gold of any test purity can be obtained in this solution, depending on the time the part remains in the dye.

Coloured inorganic compounds can, in addition to the indicated organic dyes, also be used for dyeing anodized aluminium, the Russian report stated, giving the following description of the process :

Used for this purpose are the coloured inorganic compounds which are formed directly in the pores of the anodized metal after its successive submersion first in aqueous solution (*a*) and then in aqueous solution (*b*).

In dyeing a white colour, for example, the solutions employed are: (*a*) lead acetate 10 per cent solution, (*b*) sodium sulphate (Glauber salt) 10 per cent solution.

For dark or light blue, the solutions are: (*a*) potassium ferrocyanide 5 per cent solution, (*b*) ferric chloride 5 to 10 per cent solution.

For golden-yellow : (*a*) hyposulphate 5 per cent solution, (*b*) lead acetate, 5 per cent solution.

For orange: (*a*) potassium chromate 2 to 3 per cent solution, (*b*) silver nitrate 5 to 10 per cent solution.

For brown: (*a*) potassium ferrocyanide 2 to 5 per cent solution, (*b*) copper sulphate 5 to 10 per cent solution.

After adsorptive dyeing by any of the methods cited, the parts are washed with hot water and dipped for 2 to 3 minutes in molten wax or paraffin, then, while still hot, are rubbed with gauze. The described method of protective-decorative finishing the report says, is simple and does not require chemicals.

Overseas Review

(*Continued from page* 364)

The principle of this device provides for a reciprocating side to side movement of the paint manifold while it oscillates through an arc 3 to 10 deg. from the vertical. This double motion produces on the particular plant concerned a full flow of paint from 8 nozzles effective over the same area as might otherwise be applied by a much larger number of stationary nozzles. As a result of introducing this technique, it is possible to apply 5 different colours ; colour changing taking only 30 minutes. A 75 per cent cost saving in the consumption of solvents has also been obtained as compared with their previous orthodox flow coating plant.

Still on the subject of paints, Schreiber[7] makes some essentially practical comments on the cause and prevention of paint skinning and these are worth studying from the point of view of getting the maximum efficiency from production paint shops. He stresses, for example, that wrinkle finishes are particularly prone to this trouble.

Miscellaneous

For those more interested in laboratory rather than production aspects of metal finishing, a new method of determining sulphate in chromium plating solutions has been developed[8]. This depends upon reduction of the sulphate to sulphide with a hydriodic acid reducing mixture. The liberated hydrogen sulphide is then trapped in ammoniacal zinc sulphate solution which is then titrated with a standard iodate — iodide solution. The method is claimed to be accurate, unaffected by major contaminants such as trivalent chromium and iron and can be performed in 90 minutes.

Recent work carried out at the Westinghouse Research Laboratories, Pittsburgh[9] may indicate that the rusting of iron is due to something more basic than an electrochemical reaction. They are wondering whether hydrogen ions are the whole cause of this corrosion of iron and steel which has plagued us all for so long. It will be interesting to see!

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(7) *Ind. Finishing*, 1960, **38**, (7), 21, 24, 26, 28.
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(9) *Iron Age*, 1960, **186**, (5), 107-109.

Advantages of

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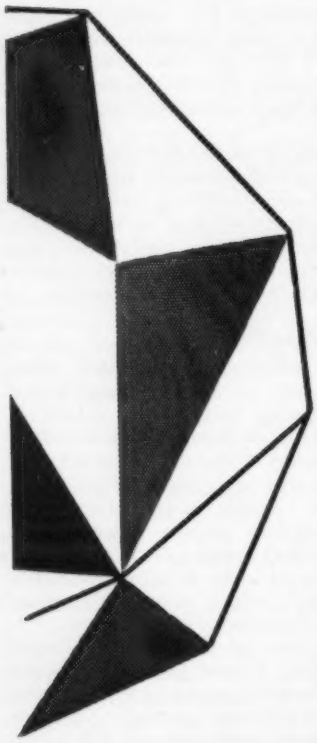


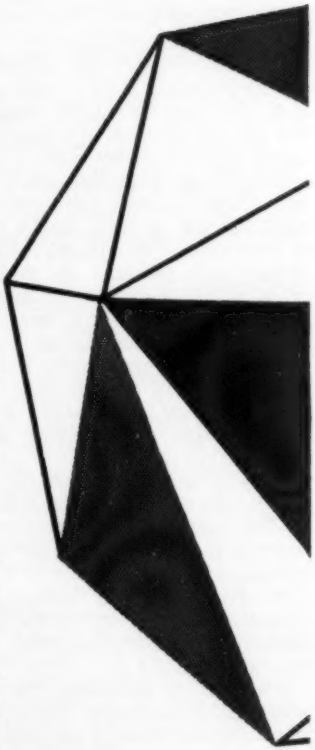
The economic advantages of using potassium stannate are very considerable.

Probably the best known application in immersion plating is the tinning of aluminium pistons. By using potassium stannate instead of sodium stannate it is possible to achieve substantial reduction of sludge formation.

Solutions containing potassium stannate have a far greater electrical conductivity than similar solutions containing the same concentration of sodium stannate. This fact, and the greater solubility of potassium stannate, mean that higher current densities are obtained for a given voltage. Conditions are ideal for barrel plating. Alternatively a dilute potassium stannate solution can give the same plating rate as a more concentrated one containing sodium stannate, so that wastage by drag-out, and initial costs, are reduced considerably.

With High-Speed tin anodes faster plating rates can be obtained. Fewer anodes are required and 'filming' is much easier.

Albright & Wilson (Mfg) Ltd. also supply Phosbrite chemical polishing solutions for copper and aluminium and their alloys, Plusbrite addition agents for bright nickel plating, together with chemicals for special processes in copper and nickel plating and electrolytic polishing of ferrous metals.



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BARRINGTON HOOPER, C.B.E.

IT is with profound regret that we announce the death of Mr. Barrington Hooper, C.B.E., Chairman of Industrial Newspapers Ltd, the company which he created 34 years ago and to the extension and development of which he had consistently and unremittingly devoted his undoubted genius in the publicity field. On September 2, after procuring a passage for Greece for a much-needed holiday, he had a fatal stroke. He was 75 years old and his early years were passed in Fleet Street, where he was on the staff of the late Lord Northcliffe, and carried through a number of his projects, such as the London to Manchester air race. This early experience led him into a number of outstandingly successful achievements, notably the promotion of the War Bond Tank Campaign in 1916, and the subsequent Victory Loan and the Food Economy Campaigns. For these services he was awarded the C.B.E. in 1920.

After a brief spell of political activity, during which he promoted the short-lived National Party, he was appointed Controller of Publicity in 1924 for the British Empire Exhibition at Wembley, the prospects of which at that time had fallen to a low ebb, and there were few recollections which gave him greater pleasure than the outstanding and world-wide success which was ultimately achieved for that event.

In 1926 he formed Industrial Newspapers Ltd. in association with, among others, Mr. Harold Jeans, who later became Chairman of the Company with Mr. Hooper as managing director, an association which continued until 1955 when he also took over the Chairmanship on the retirement of Mr. Jeans.

At the time of the company's foundation its publications, though of high repute, were relatively few, but the number grew steadily and the new approach and vigorous policy he brought to bear launched a new epoch in trade and technical journalism.

Mr. Hooper was a man of wide interests, largely concerned with the fields covered by the journals he published, and in particular he gave unstintingly his help and advice to those technical and trade Associations and Institutes with which the journals were associated. For example, his work for the Institute of British Foundrymen, the National Association of Colliery Managers, the National Federation of Fishmongers and the Institute of Sheet Metal Engineering will be long remembered. In fact, the latter two bodies were formed largely as a result of his efforts.

Few people have made so many friends in such diverse fields of activities as Mr. Hooper, and his passing will be mourned by many.

A memorial service will be held at St. Bride's Church in Fleet Street at 12.30 p.m. on Tuesday, September 20.

FINISHING NEWS REVIEW

INSTITUTE OF VITREOUS ENAMELLERS
Twenty-sixth Annual Conference

THE twenty-sixth annual conference of the Institute of Vitreous Enamellers is to be held at the Grand Hotel, Birmingham, from September 28 to October 1, 1960. Particulars of the programme are as follows : —

Wednesday, September 28, 7.0 *p.m.*. Reception of delegates and ladies, and official opening of the Confair in the Grosvenor Room and Gallery, Grand Hotel, Birmingham. The Confair is a small trade fair which is open throughout the Conference to give suppliers of goods and services the opportunity to exhibit their products to their customers.

Thursday, September 29. Annual general meeting of the Institute in the Barwick Room at 10.0 a.m., followed by the presidential address. After luncheon in the Grosvenor Room, coaches leave for works visit to either Cannon Industries Ltd., Bilston Foundries Ltd., or Valor Ltd. From 7.30 p.m. until midnight, a " Michaelmas " dinner is to be held at the Regency Club, Shirley, near Birmingham, including dancing and cabaret for delegates and their ladies.

Friday, September 30, is devoted to technical sessions, commencing at 9.15 a.m. Session "A" to be held in the Barwick Room will include the following contributions—" Abrasion Resistance," a sub-committee report and " Influence of Chemical Composition of Enamel and its Alkali Resistance " by A. N. Revell. Following luncheon in the Grosvenor Room, Session "B" commences at 2.15 p.m. in the Barwick Room when the following papers will be presented. " Influence of Water-vapour upon the Adherence Resistance between the Ground-coat and Sheet Iron " by Dr. L. Merker, " Evaluation of Aluminium Enamels" by A. W. Brace and "Enamelling Aluminium" by A. H. Symonds. A banquet reception will be held for delegates and ladies in the Barwick Room at 7.30 p.m. followed by the annual banquet in the Grosvenor Room (evening dress).

Saturday, October 1. Coaches leave at 10.30 a.m. to visit the works of Ferro Enamels Ltd., Wombourn, with luncheon at the invitation of Ferro-Enamels Ltd., leaving for return at 3.0 p.m.

Ladies Programme

A special programme has been arranged for the ladies on Thursday when coaches leave the Grand Hotel at 9.30 a.m. to visit the Royal Brierley Crystal Glass Works, taking luncheon at the Lyttelton Arms Hotel, Hagley, followed by a visit to Hagley Hall and return to Grand Hotel at 5.30 p.m.

Further details and application forms can be obtained from the Secretary, John D. Gardom, John Gardom and Co., Ripley, nr. Derby.

MAJOR PAINT INDUSTRIALISTS COMBINE INTERESTS

BERGER AND JENSON AND NICHOLSON

THE Lewis Berger and the Jenson Nicholson groups of companies have announced their amalgamation into a new concern to be known as Berger, Jenson and Nicholson Ltd. The amalgamation is scheduled to operate from September 12 ; the combined factories of the new group will include five in the U.K. and it will also have production units in Eire, France, Portugal, South Africa, East Africa, Central Africa, India, Pakistan, Jamaica, each of the six Australian States, two in New Zealand, and two in Canada. The board will consist of eight directors, four from each company ; Mr. R. E. F. Trafford will be chairman, Mr. B. J. Nicholson and Mrs. Vera Lilley vice chairmen, Mr. P. R. Herron alternate director to Mrs. Vera Lilley. Mr. W. J. Vines and Mr. John Nicholson managing directors, and Mr. C. G. Fry, Mr. S. G. Barnett and Mr. Ashley Hall (chairman of John Hall and Sons Ltd.) directors.

BLUNDELL SPENCE AND PERMOGLAZE

AN agreement has been reached for a merger to take place between Blundell Spence and Co. Ltd. and Permoglaze Holdings Ltd. ; it is the intention of both boards that the two companies shall continue to operate separately, but as soon as possible a new holding company should be formed by the present Blundell Spence and Co. Ltd., changing its name to Blundell-Permoglaze Holdings or some other suitable title, and by transferring its trading and commercial activities to a newly-formed subsidiary. The effect of this will be that the present company will become the holding company of the group and all the trading activities of the group, both at home and abroad, will be carried on by subsidiaries.

INGHAM CLARK AND SCOTTISH PAINTS

ROBERT Ingham Clark and Co. Ltd. have taken over and will develop the activities in the field of industrial and marine paints previously pursued by Scottish Paints, Renfrew and Belfast.

R. Gay and Co. (Scotland) has been formed to supply paint products for the decorative and maintenance trades, manufactured at their Renfrew works. The former interests of Scottish Paints have been incorporated, as applicable, into these two companies.

The offices of R. Gay and Co. (Scotland) are now at St. Andrews Works, Renfrew (telephone Renfrew 2392) and the Scottish office of Robert Ingham Clark and Co. will shortly be moved to the same address. The Ulster office of the two companies remains at 13, Dalton Street, Belfast, 5 (telephone 58817). The two companies are members of the Pinchin, Johnson and Associates group of companies, who are themselves members of the Courtaulds group.

INSTITUTE OF METALS AUTUMN MEETING

THE Autumn Meeting of the Institute of Metals was held in Bath from September 5 to 9. The reception committee under the chairmanship of Mr. D. M. G. Sneddon, general manager of the Imperial Smelting Corporation Ltd. of Avonmouth arranged a programme which included visits to local places of interest and works and also scientific discussions on papers which have been published in the journal. The discussion programme was divided into two sections run simultaneously; the themes for programme "A" were "Engineering Properties of Nickel-Base Alloys," Sept. 5, "Recovery and Recrystallation," Sept. 6, "The relative Merits of Extrusion and Other Methods for the Manufacture of Bar, Rod and Wire-rod," Sept. 8; those for programme "B" were "Lubricants for Cold Rolling Aluminium," Sept. 5, "Properties of Metals," Sept. 6, "Magnesium Alloys for Fuel-Element Components," Sept. 8. The last day, Sept. 9, included the Autumn Lecture on "Metals and the World of Engineering Structures," by Professor Sir Alfred Pugsley, of the University of Bristol.

COURSES IN METAL SCIENCE

THE Borough Polytechnic are arranging a series of special evening courses in the Division of Metal Science during the winter term 1960/1961. A course on "Corrosion and Protection of Metals" will be held on one afternoon and one evening a week throughout the session (*i.e.* three terms) commencing on Monday, September 26, 1960, and will deal with "Chemical and Electrochemical Principles," "Metallurgy," and "Corrosion and Protection of Metals." A course of six meetings, commencing Thursday, October 6, from 7-9 p.m., on "Recent Developments in Electrolytic Metal Finishing" will deal with recent developments in nickel, chromium and precious metals, and in anodizing of aluminium and aluminium alloys. A second evening course of ten meetings "Refractories, Their Manufacture, Properties and Uses" will commence on Friday, October 7, from 7-9 p.m. Another course, "Metallurgy of Semi-Conductors," will commence on Tuesday, October 25, also from 7-9 p.m. Applications should be made to the Senior Lecturer, Division of Metal Science, Borough Polytechnic, Borough Road, London, S.E.1.

ANGLO-AMERICAN LIAISON IN METAL FINISHING

MR. Cyril Wharrad, joint managing director of Britachrome Co. Ltd., Electroplaters, Cope Street, Birmingham 18, and also national chairman of the Metal Finishing Association, has recently returned from a visit to the U.S.A. where he visited plating plants, laboratories, and manufacturers' establishments at New York, Cleveland, Detroit, etc.

Mr. Wharrad also met the executive secretary and members of the National Association of Metal Finishers of America and discussions took place with a view to closer co-operation between the two associations and to introduce an exchange of ideas, codes and details of membership, etc. Members of the two bodies will be advised to contact their secretary before visiting the others' country and arrangements might then be made for them to be put in touch with their opposite numbers in the towns they are visiting.

* * *

WHILE visiting England and Europe recently, Mr. A. C. Benning, technical manager of the electroplating division of Harshaw Chemical Co. of Cleveland, Ohio, and a director of Harshaw Chemicals Ltd. of Waltham Cross, Herts., took the opportunity of addressing the Midland sales and technical staff of the latter company at a sales conference held in Birmingham and dealt with the present situation in the American electroplating industry and recent developments in techniques and applications. Among those present were Mr. T. I. Williams, managing director of Harshaw Chemicals Ltd., Mr. J. W. Weaver, sales manager and Mr. R. T. F. McManus, technical manager.

Following this visit, Mr. Williams left for a visit to the parent company in America to familiarize himself with the American methods. It is also understood that negotiations are proceeding with a leading manufacturer in the metal cleaning field and their products will shortly be made available in this country.

SIXTH CASTNER MEMORIAL LECTURE

THE Society of Chemical Industry announce that Dr. W. J. Kroll of Corvallis, Oregon has been appointed the 6th Castner Memorial Lecturer and will deliver his lecture entitled "The Fusion Electrolysis of Titanium" in Glasgow on Friday, October 7, 1960.

GRIFFIN AND GEORGE ACQUIRE R. AND J. BECK

GRIFFIN and George Ltd., Ealing Road, Alperton, Middlesex, have purchased the whole of the share capital of R. and J. Beck Ltd., one of the oldest established firms of optical instrument manufacturers in Britain, operating two works, at Watford and Kentish Town, and offices and a showroom at Mortimer Street, London, W.1. The total staff employed is over two hundred and as it is the intention to retain the individuality of Beck's as a separate entity, Griffin and George Ltd. have undertaken the continued employment of the existing staff. The present board will remain in office and will be joined in due course by Messrs. M. Lyth, H. C. Mayer, R. C. Palmer and F. A. Renn as additional directors representing Griffin and George Ltd.

INTERNATIONAL CORROSION CONGRESS

THE executive committee of the 1st International Congress on Metallic Corrosion have appointed the following plenary lecturers; Professor Y. M. Kolotyrkin of the U.S.S.R., Professor P. Lacombe of France and Professor H. H. Uhlig of the U.S.A. and Dr. U. R. Evans of the U.K. who hopes, circumstances permitting, to be the fourth. The response to invitations to submit papers to the Congress has been excellent and contributions are assured from many eminent authorities of world-wide repute. So far papers have been accepted from 17 countries.

FIRST EFFLUENT AND WATER TREATMENT EXHIBITION

THE First Effluent and Water Treatment Exhibition and Convention is to be held at the Seymour Hall, London, W.1, from October 18-21. Delegates to the convention can register for £3/3/-, which includes a set of thirteen papers and entry to the exhibition. The subjects covered by the papers include the treatment of industrial wastes, river pollution prevention, coastal pollution, disposal of radio-active effluent, water softening and design of effluent treatment plants. The reader of each paper is a top expert in his field and is expected to bring outstanding thought and new information to bear on these important subjects.

Further details can be obtained from Thunderbird Enterprises Ltd., 140 Cromwell Road, London, S.W.7.

TECHNICAL *and* INDUSTRIAL APPOINTMENTS

William K. Whiteford of Pittsburgh, president of the Gulf Oil Corporation has been elected a director of **The International Nickel Co. of Canada, Ltd.** Mr. Whiteford has been a member of the advisory committee of International Nickel since February 1960, and is also a director of Mellon National Bank and Trust Co. of Pittsburgh, General Motors Corporation, Jones and Laughlin Steel Corp., Procter and Gamble Co., Stouffer Corp., Bank of Nova Scotia and Canada Life Assurance Co.

* * *

Following the death of Mr. A. V. Francis, furnace division manager of **G. W. B. Furnaces Ltd.,** Dudley, Mr. W. L. Harrison has been appointed manager, and the division will operate as two units, one dealing with melting and the other heat treatment processes. Mr. J. Simpson will be sales manager (melting) and Mr. J. Nicholls sales manager (heat treatment). Mr. A. Head, for many years chief draughtsman, has been appointed chief designer.

* * *

Mr. Frederick Baillie, who joined the **Cambridge Instrument Co.** as production manager in August, 1960, will be responsible for all aspects of production planning at the company's three factories in the United Kingdom. Mr. Baillie was formerly general works manager at the Greenock factory of IBM (United Kingdom) Ltd. Prior to joining IBM in 1955, he spent a year with Muirhead and Co. Ltd. and, before that, several years with Kelvin and Hughes Ltd.

* * *

Mr. T. J. McArthur has joined the Board of **Blake Vitreous Enamelling Ltd.,** Clayton-le-Moors, as general manager.

Mr. McArthur has had many years' experience in management within the vitreous enamelling industry and until recently was a director and general works manager of Stewart and Gray Ltd.

In recent years he has been concerned with pioneering the use of vitreous-enamelled steel in building construction.

Blake Vitreous Enamelling Ltd. operate one of the largest and most modern plants in the United Kingdom and current extension will expand present capacity and enable the company to develop new products.

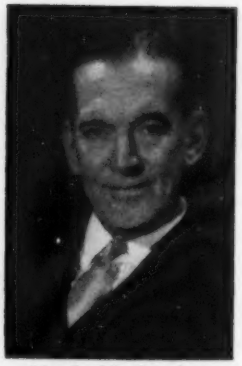
Mr. Douglas Miller, general manager of **Lewis Berger (Scotland) Ltd.,** has been appointed a director of Lewis Berger (Great Britain) Ltd., and will act as general sales manager (trade and retail).

* * *

The re-constituted board of **Metal Cleaning Ltd.** consists of Leonard M. Broadway, who is deputy chairman and managing director of Castrol Ltd., as chairman, J. A. V. Watson, another Castrol director, as deputy chairman and Arthur Owen as managing director. Other members of the board are E. B. Bishop, J. C. Cragg, George Owen and G. J. B. Williams who is also secretary of the Company.

* * *

At the annual meeting of the governing council of **American Platers' Society, Inc.** (**AES**) held July 28, 1960 at the Statler-Hilton Hotel, Los Angeles, California, Dr. W. Andrew Wesley of Plainfield, New Jersey, (an executive of the International Nickel Co.), was unanimously elected National President for 1960-61, succeeding Ralph D. Wysong (Studebaker-Packard Corporation).



Mr. L. M. Broadway

Dr. W. A. Wesley

RETIREMENT

DR. J. C. Hudson, D.SC., D.I.C., A.R.C.S., F.I.M., who has been in charge of the British Iron and Steel Research Association's research on corrosion for the last 15 years, retired at the end of August. He will, however, continue to have very close ties with the Association, since he has agreed to act as consultant to both the Corrosion Advice Bureau and the Chemistry Department. Dr. Hudson has recently received two major awards in recognition of his outstanding contributions to corrosion engineering and ferrous metallurgy — the Frank Newman Speller Award for 1959 from the American National Association of Corrosion Engineers, and the Sir Robert Hadfield Bronze Medal for 1960 from the Iron and Steel Institute. He has published well over one hundred original papers, including two books, "The Corrosion of Iron and Steel" and "Protective Painting of Structural Steel," the latter in collaboration with Mr. F. Fancutt, M.B.E.

NATIONAL SAFETY CONTEST

THE finalists in the National Safety Contest were recently presented with prizes valued at £1,000 at the Church House Restaurant, Westminster, by Mrs. Patricia McLaughlin, M.P. for Belfast West and secretary of the Parliamentary Home Safety Committee. The contest was sponsored by a number of leading firms and industrial organizations who each subscribed 200 guineas to run the campaign. The first prize of £500 went to Mr. S. W. Nobbs, a retired insurance official, whose idea was that all cars should be manufactured with a sliding door. The second and third prizes, totalling £400, were shared by Mr. J. Bibby and Mr. K. R. Hall who both had the same basic idea that a metal shim should be inserted in the sole of all rubber boots to prevent nails and other sharp objects penetrating the foot.

TECHNICAL BOOKSHELF

1958 References on Fatigue STP 9-J. American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 76 pp., self cover, duplicated. $3.50.

This list of references to articles published in 1958 dealing with fatigue of structures and materials is a continuation of a series started in 1950. There are 386 references. While the list is extensive it is not exhaustive and is so arranged that the sheets may be cut for filing. Where possible, brief abstracts have been included. All 9 reference volumes dating back to 1950 are available for $15.00.

Symposium on Aluminium in Building. The Aluminium Development Association, 33 Grosvenor Street, London, W.1. 256 pp., £2 10s.

THIS book, which is profusely illustrated, partly in colour, is a report of the proceedings of the event held at the Royal Institute of British Architects on July 9 and 10, 1959, and comprises the final version of 13 papers, presented at three sessions, together with the discussion which followed each session. The symposium was convened in order to provide the opportunity for architects, builders and engineers to exchange ideas and information with the aluminium industry with the object to help forward the development of further new items by the aluminium industry and manufacturers. The report is in three divisions; Aluminium as a Building Material (3 papers), Aluminium Curtain Walling (4 papers) including surveys of curtain walling in this country, North America and Europe, and Aluminium Building Applications (6 papers).

The Electrolytic and Chemical Polishing of Metals in Research and Industry. W. J. McG. Tegart, M.SC., PH.D., Pergammon Press. 139 pp., 35 figs. 40s.

THIS book first appeared in 1955, and the present edition has been revised and appreciably enlarged. There is now also an extensive bibliography, which, however, contains very few references later than 1952. Like the original edition, the book confines itself largely to the metallurgical side of electrolytic and chemical polishing, and the application of these processes to research. Some twenty pages are devoted to electrolytic and chemical polishing in industry, which is not really adequate to do justice to the subject.

These points do not, however, seriously detract from the value of the book, which is clearly and concisely written and well illustrated, to anyone interested in the subject. It deals adequately with the theory of the methods used and the factors affecting the results. There are also chapters on apparatus and on the electrical characteristics of polishing, while a tabular section listing a very wide range of available laboratory methods is especially useful.

Chemical and electro-polishing are making some progress in industry, albeit rather slowly. Most of the methods used in practice are, however, proprietory ones, and on these the authors have only been able to include a limited amount of information.

H. SILMAN

Recommended Practices for Metallizing Shafts or Similar Objects. The American Welding Society, Dept. T., 33 West 39th Street, New York 18, N.Y. $1.00 post paid.

A NEW revision of the Recommended Practices for Metallizing Shafts or Similar Objects, has been published by the American Welding Society. This 32 page booklet is well illustrated with diagrams, line drawings and halftones, contains many tables and was prepared by the AWS Committee on Metallizing.

A new Section has been introduced on Surface Preparation for Metallizing. All surfaces to be metallized have to be roughened and the degree of roughness greatly affects the strength of the bond. Accordingly, the methods of roughening have been divided into three groups and recommendations are given as to when to use a particular method.

Most of the material has been rewritten to bring it up-to-date and the contents have been rearranged for quicker reference. The material has been divided into four Sections : General, Surface Preparation, Spraying, and Finishing. Copies of this valuable little booklet are available, price $1.00 post paid, from the American Welding Society, Dept. T, 33 West 39th Street, New York 18, N.Y.

EXHIBITION OF HIGH TEMPERATURE ALLOYS

HENRY Wiggin and Co. Ltd. are holding an exhibition concentrating entirely on high-temperature alloys, supplemented by lectures on high-temperature problems and supported by films. The exhibition, which is entitled " When it's really hot " is being held at the Grand Hotel, Sheffield, September 20-22 and at More's Hotel, Glasgow, September 27-29, and will demonstrate properties and applications of high-temperature alloys by diagrams and animations and a comprehensive range of exhibits of components in which Wiggin materials are used.

INDUSTRIAL FILMSTRIPS

THE Industrial Welfare Society have recently given a preview of eight new filmstrips designed for training in management and supervision. The new films in the series " Training," and " Human Problems at Work " have the familiar recorded commentary typical of these filmstrips and are supplied with a list of suggested questions to promote interesting and constructive discussion. The films are available on request from the Society at Robert Hyde House, 48, Bryanston Square, London, W.1.

OBITUARY

Hosdowich. J. Merle Hosdowich, chromium plating pioneer, died at Tucson, Arizona, on July 15 last, aged 65. He retired from Metal and Thermit Corporation, New York, last year after 35 years' association with that concern, and was the author of numerous technical papers and articles on chromium plating as well as a frequent speaker before professional and technical societies.

Hesse. The death occurred recently of Mr. L. M. Hesse, London Area Manager of The Geigy Co. Ltd. Mr. Hesse had been with Geigy all his working life and moved from Manchester to London as Area Manager shortly after the last war.

WASHING FACILITIES IN FACTORIES

A publication, S.I. 1960 No. 1214, issued by H.M. Stationary Office, price 3d. net., deals with regulations regarding washing facilities in factories which came into operation on 1st. August and brings various regulations, introduced from time to time, into line with Section 18 of the Factories Act of 1959.

Trade and Technical Publications

Translation and Technical Information Services of 32 Manaton Road, London, S.E.15, have produced a bibliography on "Water-Thinned Stoving Finishes" which have become the centre of attention since 1953 when a fire, attributable to solvent paints, occurred at General Motors Hydromatic Division and cost the company some $35 million. While the majority of the present day finishes were evolved for the automobile industry, they have also been considered for use in appliance finishes and certain companies have developed water-thinned electrical impregnating resins and wire enamels. There is a total of 58 references most of which cover articles written by the staff of the resin manufacturing companies about their own products. The bibliography is published at 5/-.

* * *

The painting of shot-blasted steel, specialized protective treatment for aluminium and galvanized iron, and time tested anti-corrosive protectives and finishes are among the subjects comprehensively covered in a manual of marine paints, published by John S. Craig and Co., Ltd.

The manual first analyses in detail the requirements for protective and decorative finishes on metals in specialized conditions, and then provides recommendations to meet the individual requirements of users. Although produced primarily for the shipbuilding and marine trades, the manual, both in its general scope and detail of subjects covered, is of direct interest to the heavy steel and metal industries.

Copies may be had upon request from John S. Craig and Co., Ltd., 12-40 Bogmoor Road, Glasgow, C1.

* * *

C. & P. Development Co. (London) Ltd., of Redhill, Surrey, manufacturers of Rust-Anode zinc-rich paint, have issued a leaflet on their "Skaline" mill scale remover.

The purpose of "Skaline" is to prepare surfaces prior to the application of protective coatings. It makes a most useful pre-treatment of metal before applying "Rust-Anode" particularly where mill scale is prevalent, and when sand blasting is impracticable or impossible on standing structures and equipment.

The U.K. Glycerine Producers' Association Ltd., 5 Bridewell Place, London, E.C.4 have recently issued a 20-page booklet "Glycerine in Paints and Resins," describing the use of glycerine in paint and resins, including useful physical data and specifications of glycerine relevant to the paint and resin industry.

* * *

Precision Components (Barnet) Ltd., Kabi Works, Cranborne Road, Potters Bar, Middlesex, makers of polythene bowls, buckets, bins etc. have issued an illustrated leaflet giving prices and descriptions of the range of articles produced by them.

* * *

"The Bonderizer," published by the Pyrene Co. Ltd., Metal Finishing Division, Great West Road, Brentford, Middlesex, for June 1960, contains an interesting article on the use of steel partitioning for office construction as supplied by the Norwood Steel Equipment Ltd. The Pyrene Co.'s "Sales Information Bulletin" No. 3 introduces "Pyroclean" No. 9—a heavy-duty alkali type cleaner supplied in powder form and used in aqueous solution normally within a temperature range of 190-205°F. for cleaning iron and steel; it can also be used in still tanks, automatic plants combining dip and spray, spray cleaning machines and in the cleaning sections of automatic metal pre-treatment plants.

* * *

A recent edition of "Wiggin Nickel Alloys" includes an article on eddy current testing, one aspect of the company's comprehensive and exacting system of quality control.

Contrasting uses of nickel and nickel alloys are featured—from anodes for electroplating, one of the oldest, and best known applications, to the use of some of the Nimonic series of heat-resisting materials in the Zenith experimental gas-cooled nuclear reactor.

Other articles include the use of Nimonic 80A in valves for the Vanwall racing car and two seagoing applications of Monel alloy in trawlers and runabout pleasure craft.

This publication is free on request from the Publicity Department, Henry Wiggin and Co. Ltd., Thames House, Millbank, London, S.W.1.

The Sel-Rex Corporation of Nutley, New Jersey, U.S.A. offer reprints, free of charge, of an article from the February edition of the American Jewellery Manufacturer, entitled "Testing and evaluating Precious Metal Electroplate," by Dr. Karl Schumpelt, chief electrochemist of the Sel-Rex Corporation, consisting of a six-page article on two important requirements for electroplated articles—resistance to corrosion by body acids or by air oxidation and resistance to mechanical or abrasive wear.

* * *

"Pitan Technical Digest" No. 134 issued by Allweather Paints Ltd., 36 Great Queen Street, London, W.C.2, describes the use of "Pitan Metal Conditioner" which combines the benefits of metal pre-treatment with the first coat of a paint system and is so formulated that it bonds itself to metal and becomes an integral part. It is suitable for non-ferrous metals as well as steel and other ferrous metals but when applied to steel or cadmium, the most difficult metal of all, has an adhesion of over 3,000 lb. per sq. in.

* * *

Abstracts indicating the scope and main findings of papers presented at the 46th Annual Convention of the America Electroplaters' Society form an interesting feature of a recent issue of "The Nickel Bulletin." issued by The Mond Nickel Co. Ltd., Thames House, Millbank, London, S.W.1. These and the other items comprising the section concerned with nickel plating cover work on the properties of plating solutions and electrodeposits, research on corrosion testing, and, in particular, investigations carried out with the aim of developing methods of improving the corrosion-resistance of electrodeposited coatings.

In the nickel section of the issue reference is made, *inter alia*, to items on analysis. Worthy of note in the section on non-ferrous alloys is an abstract of a paper reporting work on nickel-containing gunmetals, while the items on heat- and corrosion-resisting alloys and steels range in subject matter from the mechanical properties of high-temperature alloys to fuel-oil-ash corrosion, use of austenitic steels in steam-power plant, potentiostat studies, and the behaviour of various materials in the presence of specific corrosive media.

In addition to the usual sections concerned with cast iron and constructional steels, the issue contains the quarterly review of recent patent literature.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Deburring and Finishing Machine

FIG. 1 illustrates the Almco Supersheen Super Mite DBM-10 deburring and finishing machine which has been specially designed and produced by Almco Supersheen of Great Britain Ltd., Bury Mead Works, Hitchin, Herts. for research departments, laboratories and for processing small quantities of parts. The machine is portable and compact and is claimed to deburr and finish parts to close tolerances in a fraction of the time and cost needed for carrying out these operations by hand. The barrel is rubber-lined and revolves on hard rubber rollers which are hard wearing and quiet in operation. The barrel dimensions are 12 in. in diameter by 8 in. wide, has a capacity of ½ cu. ft. and revolves at an infinitely variable speed between 19 and 38 r.p.m. Speed can be varied easily by means of a handwheel fitted to the frame ; drive is provided by a ¼-h.p. 220-volt single-phase motor through a fully guarded pulley. The overall dimensions are 2 ft. 2 in. in height, 2 ft. 6 in. in length, 1 ft. 6 in. in width, and the weight is 96 lb.

Fig. 1.—Deburring and finishing machine

Corrosion Deterrent

THE Plus-Gas Co. Ltd., 1 to 11 Hay Hill, London, W.1., have produced a solution for the pre-treatment of rusted metal surfaces before painting, Formula " E," a non-acid, non-toxic fluid, made from a special blend of tannins, which combine with the oxides on already corroded metals (ferrous or non-ferrous) to form a hard and insoluble tannate film. This film is claimed to halt further corrosion by making the metal inert and at the same creating a surface which bonds well with all recognized industrial paints and increases their covering capacity. The solution is claimed to be safer and easier to use than phosphate or phosphoric acid compounds, as well as being cheaper, and can be of assistance in welding and flame cutting operations since lightly corroded plates can be resistance welded after treatment with the fluid and an oxy-acetylene flame will burn away the film without leaving any slag deposits.

Precision Lapping Machine

THE " Flexibox Mark 15A Lapping Machine," has been produced by Flexibox Ltd., Nash Road, Trafford Park, Manchester 17, for the precision lapping of a wide range of articles made from almost any constructional material, plastics, light alloys, ceramics, ferrous metals etc.

It is a completely self-contained unit and its compact overall dimensions of 32 in. by 22 in. by 20 in. enable the machine to be bench mounted, thus minimizing space requirements, and anti-vibration pads eliminate the need for bolting down.

A 15-in. diameter lapping plate equipped with three wear rings enables 66 components of 1 in. diameter to be lapped at one time ; larger components up to a maximum diameter of 5½ in. can also be handled.

An automatic flatness control device maintains the lapping plate truly flat at all times so that the machine can be operated by unskilled personnel. The machine is also fitted with a timing device which can be pre-set for any desired interval, (for normal use the range is 0-60 min.), at the end of which the drive motor is automatically shut off. Coloured warning lights give a clear visual indication of whether the machine is in operation or not so that constant supervision during running is unnecessary.

(*Continued in page* 378)

Abrasive Band Machine with Dust Extractor

B. O. Morris Ltd., of Morrisflex Works, Brinton Road, Coventry, have recently released an abrasive band machine, which incorporates a dust-extractor unit as a pedestal, thus making a self-contained compact unit for all types of light hand-held grinding work. (Fig. 2.)

The basic machine is the model " M.160 " which consists of a 1-h.p., 3-phase, totally enclosed, fan-cooled motor (or ¾-h.p. single-phase) driving a 5-ft. abrasive belt 1-in. or 2-in. wide, over a jockey pulley and a contact wheel. The belt speed is constant at 6,000 surface feet per minute.

A set of 4 rubber contact wheels, ranging from 1⅜-in. dia. x 1-in. wide to 4-in. dia. x 2-in. wide, is provided ; also a " Shearflex Wheel " 4-in. dia. x 2-in. wide is available for arduous work. A useful " 3 in 1 " attachment can also be employed, consisting of a spindle for carrying a grinding wheel or wire brush on the left of the contact wheel, and a collet for mounted points or rotary burrs, on the right-hand side.

The machine is mounted on a dust extractor model " M.475," motorized, ¾-h.p., having 475 cu. ft. per min. capacity, and is complete with hoods and trunking.

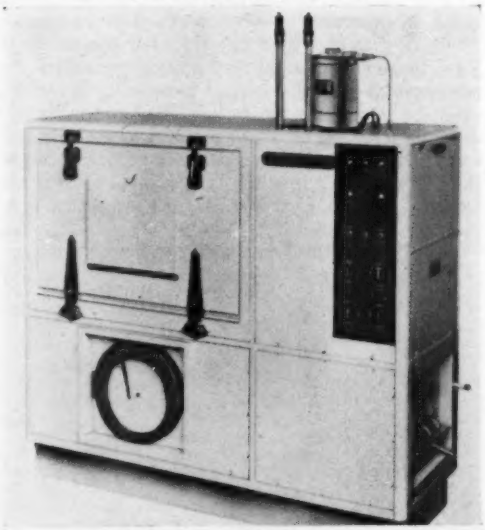
Fig. 2—Abrasive band machine

Humidity Test Cabinet

FIG. 3 shows the Barlow-Whitney Humidity or Climatic Test Cabinet, model HTC. 2B for the testing of plated finishes, paints and varnishes, packaging, electrical components, etc.

Performance characterstics include dry heat to 100°C., wet heat to 70°C., relative humidities from 40 per cent to 100 per cent, temperature control limits 0.5°C., or better and controlled rapid cyclic temperature variation under damp heat conditions with adjustment for amplitude and frequency. Facilities are provided for the entry of electrical leads to the chamber interior to enable components to be tested under operating conditions. Circulating equipment ensures even temperature and humidity distribution throughout the working space. Protective devices against water failure and overheating are incorporated. The makers are at 2, Dorset Square, London, N.W.1.

Fig. 3—Humidity-test Cabinet



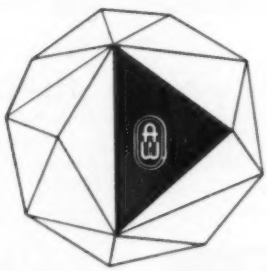
General-purpose Polarograph

THE Cambridge Instrument Co. Ltd., of 13, Grosvenor Place, London, S.W.1., have recently produced a general-purpose polarograph which can be purchased in a simple and inexpensive form for manual plotting from a galvanometer and, later, by adding separate units, may be built up into an accurate and rapid pen-writing instrument. The company have also issued a list of thermometer regulators for controlling processes which are either heated or cooled by gas or electricity. The ranges available include all temperatures from 10° to 100°F. and 0° to 600°C.

(*Continued in advt. page* 28)

SBSF Nickel + Plusbrite Nickel = Plusbrite Duplex

The best formula for a fully bright nickel plate with maximum corrosion resistance



SBSF is the new nickel plating bath based on PB-SF, a sulphur-free addition agent for use where maximum corrosion resistance is required.

SBSF has excellent levelling characteristics and produces a uniform semi-bright deposit of high ductility and low internal stress. This semi-bright finish can be buffed. Alternatively a further deposit, from a Plusbrite Nickel (PB-N1 and PB-N2) electrolyte will produce a fully bright nickel plate particularly suitable for car trim and similar products which require a bright finish and good corrosion resistance. Plusbrite addition agents are easily controlled and are not removed by filtration, so operating costs are kept to a minimum.

Plusbrite

addition agents provide

THE LOWEST PRICED NICKEL PLATING PROCESSES

Write for full details to

Metal Finishing Department
ALBRIGHT & WILSON (MFG) LTD
1 Knightsbridge Green, London SW1
Telephone: KENsington 3422

TPW/880

Plant, Processes and Equipment

(*Continued from page* 378)

Plastic Glaze

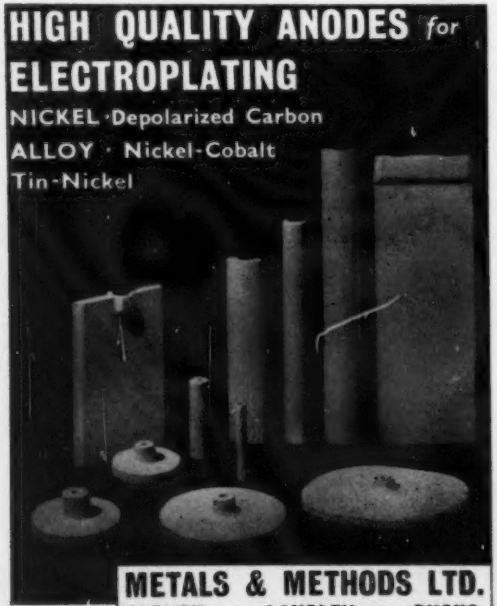
CORROSION Ltd. of Southampton, whose London office is at 16 Gloucester Place, London, W.1., are now marketing generally for the first time, a plastic glaze, "Polytile," which is specially suitable for use in conditions where stringent hygienic requirements apply or where a high degree of resistance to humidity, chemicals, solvents, fats and greases is required. The glaze can be applied by brushing or spraying and dries to a smooth coating with almost tile-like hardness and with a high gloss. It can be used on most types of constructional material including iron and steel and has heat resistance up to some 400 F., good resistance to water and water vapour and will successfully withstand cleaning with detergents and disinfectants. No stoving is required.

Cellulose Wipers

KIMBERLEY-CLARK Ltd., Larkfield, Maidstone, Kent, have produced a disposable wiper suitable for a wide range of uses including wiping and cleaning jobs where liquids, light oils, grease and dirt are involved. They are made of soft, strong, highly-absorbent cellulose and due to their creped construction and excellent conformability, are claimed to pick up dust and dirt particles better than cloth and to be more economical. The wipers measure 14¼ by 10 in. and are packed interleaved 100 to a self-dispensing carton.

Hard Gold Plating

JOHNSON Matthey and Co Ltd., of 73-83 Hatton Garden, E.C.1., are producing an acid hard gold plating process for use on printed circuits in the electronics industry which is claimed to produce gold deposits of optimum durability and overcome the tendency of the laminate bond to fail due usually to the effect of free cyanide. The gold deposited is said to have a Vickers hardness of 120-130.



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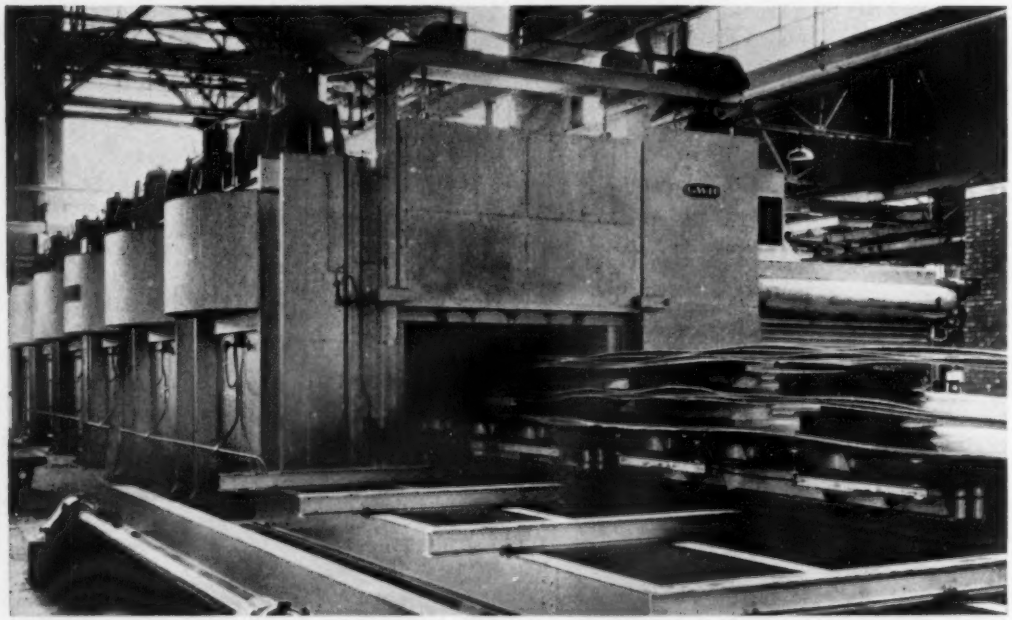

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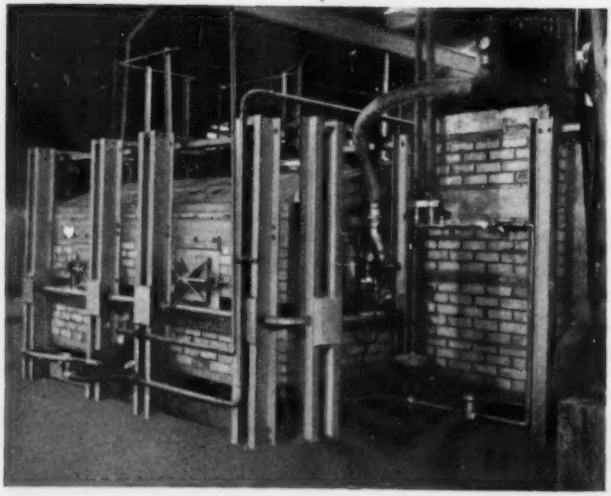

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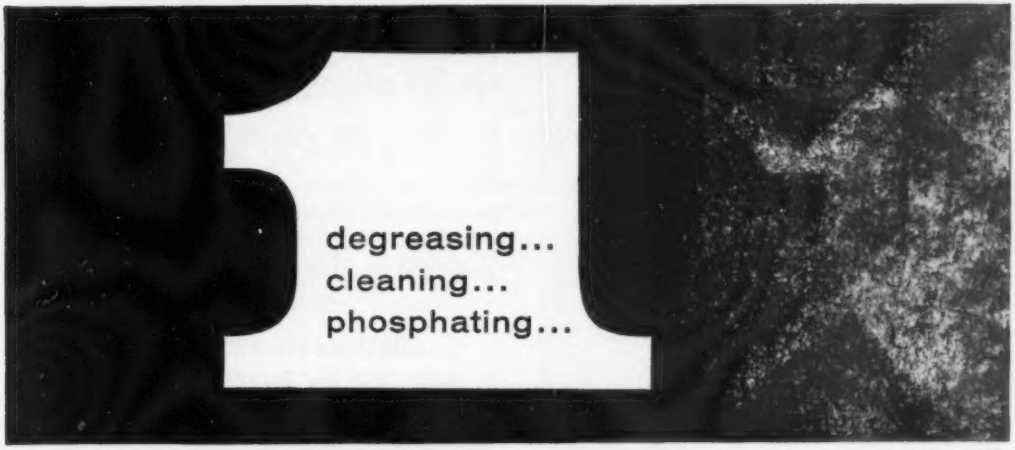

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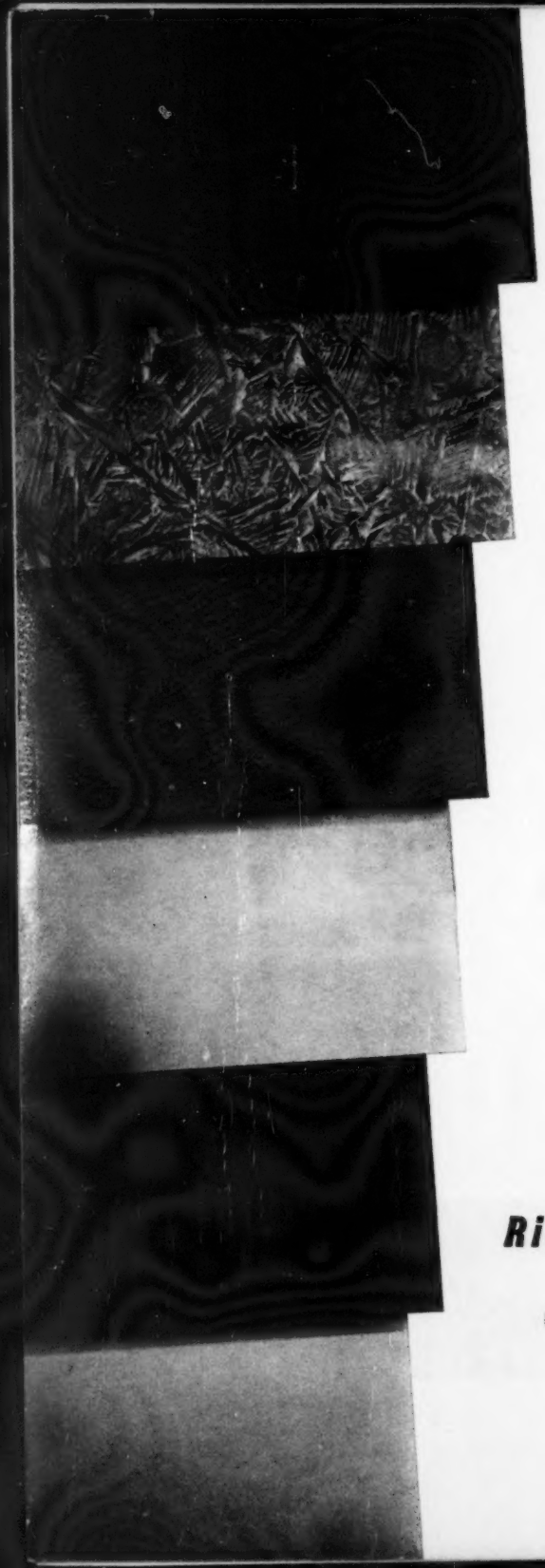

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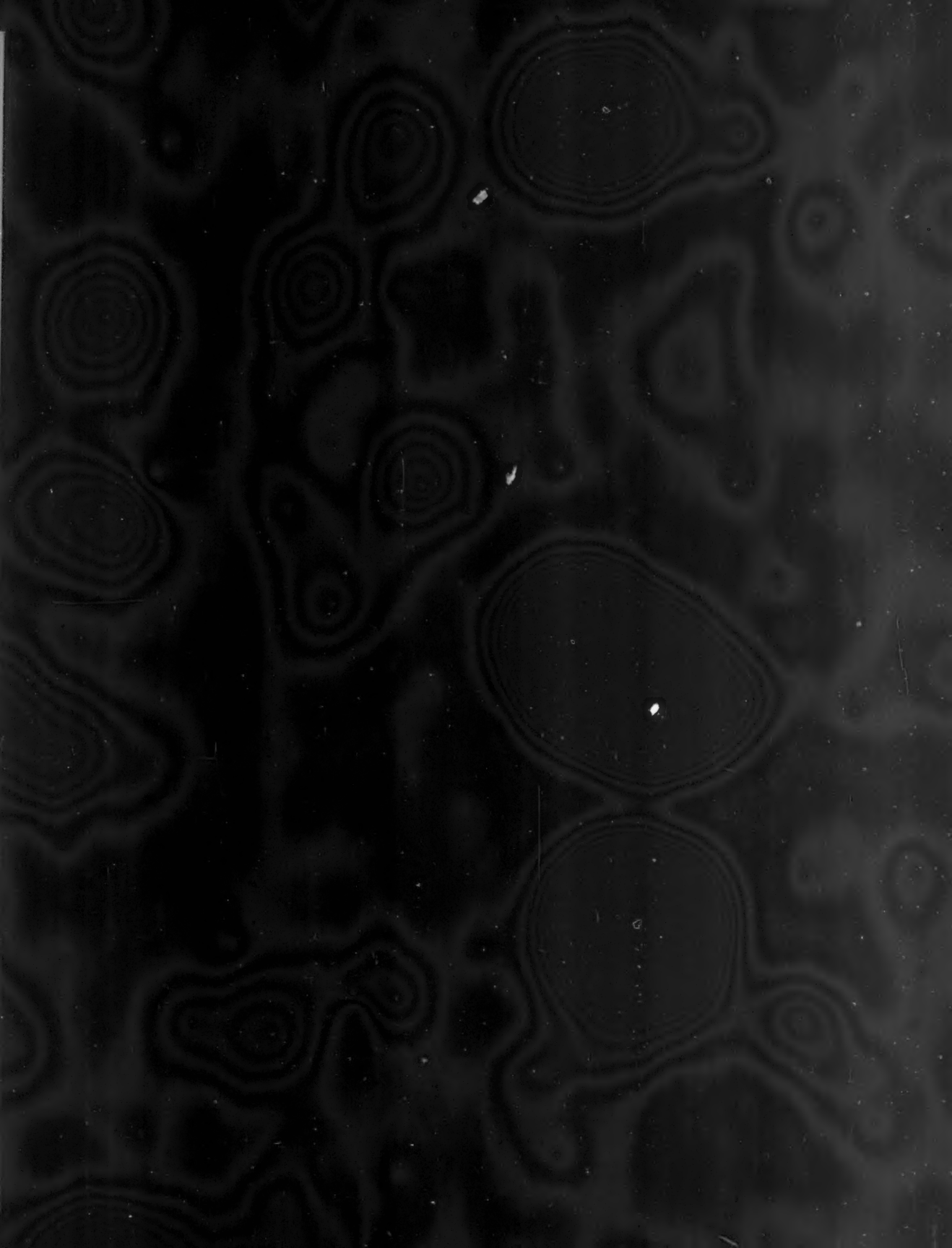
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